City of Alameda

SMART CITY MASTER PLAN

ADMIN DRAFT

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Prepared by:

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Acronyms

ACOE	Alameda County Office of Education
ACTC	Alameda County Transportation Commission
AMP	Alameda Municipal Power
ARPD	Alameda Recreation and Parks Department
ATCMTD	Advanced Transportation and Congestion Management Technologies Deployment (grant)
ATMS	Advanced Traffic Management System
AUSD	Alameda Unified School District
AVL	Automated Vehicle Location
BUILD	Better Utilizing Investments to Leverage Development (grant)
CCPA	California Consumer Privacy Act
CCTV	Closed Circuit Television
CENIC	Corporation for Education Network Initiatives in California
CIP	Comprehensive Investment Plan (grant)
CMAQ	Congestion Mitigation and Air Quality Program (grant)
CPRA	California Privacy Rights Act
CTC	California Transportation Commission
CV/AV	Connected Vehicles/Autonomous Vehicles
DMZ	Demilitarized Zone (network security term)
DOJ	Department of Justice
DRT	Digital Realty Trust
EOC	Emergency Operations Center
EVP	Emergency Vehicle Preemption
FAST	Fixing America's Surface Transportation
FHWA	Federal Highway Administration
GHG	Greenhouse Gases
GPS	Global Positioning System
GTT	Global Traffic Technologies
HVAC	Heating, Ventilation, and Air Conditioning
HOV	High Occupancy Vehicle
HSIP	Highway Safety Improvement Program (grant)
IIJA	Infrastructure Investment and Jobs Act (grant)
ISP	Internet Service Provider
ISTEA	Intermodal Surface Transportation Efficiency Act (grant)
IP	Industrial Protocol (Ethernet)
IT	Information Technology
IOT	Internet of Things
ITIP	Interregional Transportation Improvement Program (grant)
ITS	Intelligent Transportation Systems
LPR	License Plate Recognition
MAN	Municipal Area Network
MB	Megabyte
Mbps	Megabits per second
MPO	Metropolitan Planning Organization
MTC	Metropolitan Transportation Commission (Bay Area MPO)
NEMA	National Electrical Manufacturers Association
NLC	National League of Cities
P3	Public-Private Partnership
POS	Point of Sale
ROW	Right-of-Way
RTIP	Regional Transportation Improvement Program (grant)
SCADA	Supervisory Control and Data Acquisition
SFI	Settlement-free Interconnection
SHA	State Highway Account (SHA)
STIP	State Transportation Improvement Program (grant)
TIGER	Transportation Investment Generating Economic Recovery (grant)
TSP	Transit Signal Priority
USA	Underground Service Alert
USDOT	United States Department of Transportation
VDS	Video Detection System

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CHAPTER 1: INTRODUCTION

In this Chapter

- Summary of Plan Purpose
- Description of Plan Approach
- What is a Smart City?

Plan Purpose

The City of Alameda (City) has initiated this Smart City Master Plan (Plan) to provide a roadmap for improving the City's Smart City infrastructure to better serve the City's growing technology needs. The Plan will assist the City in using new technologies to improve community member's lives and to achieve the City's General Plan goals. This document includes the evaluation of the City's existing infrastructure to determine its applicability to the City's technology-related goals.

The City recognizes that new technologies are being introduced on a seemingly daily basis. Intelligent Transportation System (ITS) field devices, once considered static, are now generating massive amounts of useful data. Bandwidth on communications networks that was miniscule not too long ago, has now grown exponentially. The introduction of 5G wireless communications will make widespread Gigabit communications (1,000 Mbps+) a reality in the near future. The result being that an abundance of raw data can now be quickly transformed into actionable information, providing insight that can be acted upon by public agencies to improve the quality of life in their cities.

A key component of the Plan involves the use of software and hardware solutions to solve identified needs and meet demands, which requires data networks to provide communication between these solutions. Fiber optic infrastructure is part of a core network known as the Fourth Industrial Revolution for edge computing, which includes ultra-high speed 5G, for improved transportation operations, increased civic engagement, improved innovation and digital inclusion (such as youth and senior programs or programs for people who are disadvantaged or lower income). The Plan will look into short- and long-term solutions given the infrastructure already in place and what might further be developed. Given the potential of technology, the Plan's target objectives are as follows:

- ***Government Transparency***: Bring together infrastructure and technology to improve the quality of life of community members by enhancing their interactions and government transparency and responsiveness with the potential for open data portals;
- ***Climate Action***: Reduce traffic emissions, water and electricity use, and advance the City's Climate Action goals including monitoring environmental quality indicators such as air quality and protecting the environment;
- ***Equitable Internet***: Provide an equitable internet access option for telecommuting, tele-schooling and telehealth to ensure digital inclusion, especially for disadvantaged populations;
- ***Safety***: Improve safety with emergency response optimization, disaster early-warning signals and vehicle-to-vehicle communications including advanced

collision avoidance systems while reducing threats from cyber-attacks;

- ***Transportation Operations***: Improve efficiency of transportation operations such as with interconnected traffic signals, autonomous vehicles, real-time public transit information, multimodal data collection, smart parking, smart streetlights, predictive maintenance and car/bike sharing; and
- ***Economic Vitality***: Improve economic vitality by ensuring innovation with new technologies and considering pilot modal smart neighborhoods such as Alameda Point, Northern Waterfront or Webster Street area.

This Plan's intent is to provide a comprehensive plan that leverages the City of Alameda's existing infrastructure while introducing new technologies for the purpose of improving air quality, vehicular, pedestrian, bicycle, and transit access and safety; accommodating emerging micro mobility and autonomous vehicles; and improving the City's communications infrastructure to support the City's growing technology needs.

What is a Smart City?

According to the National League of Cities (NLC), a Smart City is one "that has developed some technological infrastructure that enables it to collect, aggregate, and analyze real-time data and has made a concerted effort to use that data to improve the lives of its residents."[1] As technology continues to change rapidly, many Cities are making efforts to continue to be on the cutting edge of technology and utilizing it to enhance public service. With new advancements in communications (e.g., 5G), cloud-computing, the "Internet of Things" (IOT), autonomous and connected vehicles, transportation-related hardware and technology, utility management, and even smart sensors, there are countless opportunities for agencies to harness these technologies to serve the community's needs.

> "…a **Smart City** is one "that has developed some technological infrastructure that enables it to collect, aggregate, and analyze real-time data and has made a concerted effort to use that data to improve the lives of its residents."

As can be expected of any new technology, these tools and strategies require a robust network of high and low bandwidth connectivity, as data transmission is a key element for implementation. Thus, an approach to build out the foundation of a Smart City is an important element of this Master Plan, to position the City of Alameda to begin executing on its vision and utilizing cutting edge technology to do so.

It should also be noted that Smart City elements should also include consideration for organizational and human factors as part of the equation. A Smart City requires collaboration, community engagement, and also investment in human capital to serve the greater need of the intended user population. This mission fits in well with the City's purpose to serve its community.

Smart City Trends

The past several years of technological development in this area has yielded quite a few Smart City trends which have been adopted

[1] "Trends in Smart City Development: Case Studies and Recommendations", National League of Cities, 2016. https://www.nlc.org/wp-content/uploads/2017/01/Trends-in-Smart-City-Development.pdf ("NLC Smart City Report)

by municipal agencies nationwide. These trends were analyzed by the National League of Cities in the previously mentioned report which many cities are now using as a guideline for Smart City development. The main findings of this report conclude that a Smart City is comprised of three primary elements which work together in concert:

1. Computing and telecommunications infrastructure to collect data,
2. Software applications and tools which analyze and interpret the data collected, and
3. A collaborative environment in the organization that continues to innovate, create, and use the Smart City applications.

The report notes that the internet provides the basic ecosystem by which we can achieve these goals and fully utilize the Internet of Things to the advantage of the agencies. This data and the associated tools will enable a city to improve administrative functions, support new development and initiatives, improve environmental impacts, attract and support businesses and economic development, and improve transportation services. These trends have been considered during the development of this Smart City Master Plan.

Additionally, the report details recommendations for establishing Smart City initiatives and include the following:

- **Cities should consider the outcomes they want to achieve.** Clearly defining the goal of an initiative will ensure that it'll be useful to the City.
- **Cities should look for ways to partner** with educational institutions, non-profits, and the private sector.
- **Cities should continue to seek and implement Smart City best practices and frameworks for 'smart city' development** as they become available and improve.

These recommendations have also informed the development of this Smart City Master Plan.

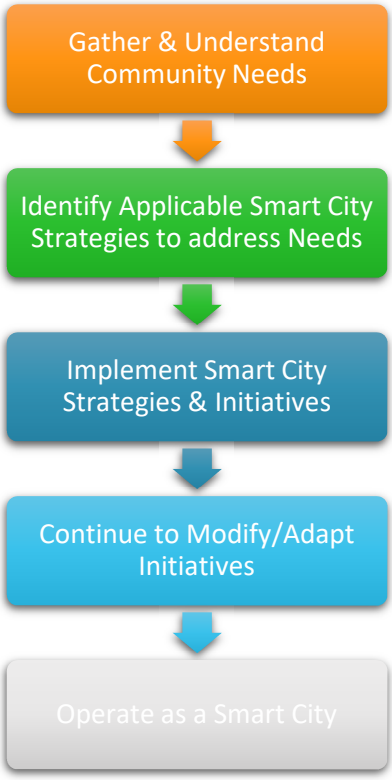
Plan Methodology

To prepare this Plan, City staff prepared a representative list of stakeholders whose input would help to shape the vision of the Plan. Generally, these groups included:

- City Departments;
- Local Institutional, Business, and Community Organizations; and
- Regional Partner Agencies.

To gather input for this Plan, focus groups were held where specific technological needs were solicited from varying representatives from these three categories. Following collection of this information, the base-level needs assessment for this Plan were documented. These needs informed a selection of strategies which seek to address the described needs. And finally, these strategies informed the general recommendations of this Smart City Master Plan.

It's important to ensure that the Plan provides solutions that are consistent with the actual needs of users, since having unused infrastructure or technology is not the goal of a Smart City. Thus, the recommendations herein are associated with the overall objectives of this plan to ensure that consistency and efficiency are incorporated into the solutions, and that the strategies employed position Alameda to become a Smart City.



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CHAPTER 2: Vision, Goals & Objectives

In this Chapter

- Define the City's vision in becoming a Smart City
- Summarize the goals and objectives of Smart City initiatives

Vision

The City of Alameda is poised to enter into the Smart City realm as the need for more and faster services grows in the City. This plan will seek to provide a roadmap to achieve the City's vision:

> The City of Alameda will harness Smart City technology to improve its community members' lives in Alameda.

As a Smart City, the City of Alameda will:

- ✓ Increase productivity and efficiency in City services,
- ✓ Be hospitable to business and economic growth in Alameda,
- ✓ Increase quality of life for all in Alameda,
- ✓ Improve multi-modal movement and safety on Alameda, and
- ✓ Be environmentally responsible.

To realize this vision, the City must define specific goals to work towards within the City as part of this Plan.

Goals & Objectives

As technology needs in the City have evolved greatly, the City has developed a list of Smart City goals and objectives. The City's high-level Smart City goals are shown in **Figure 1**.

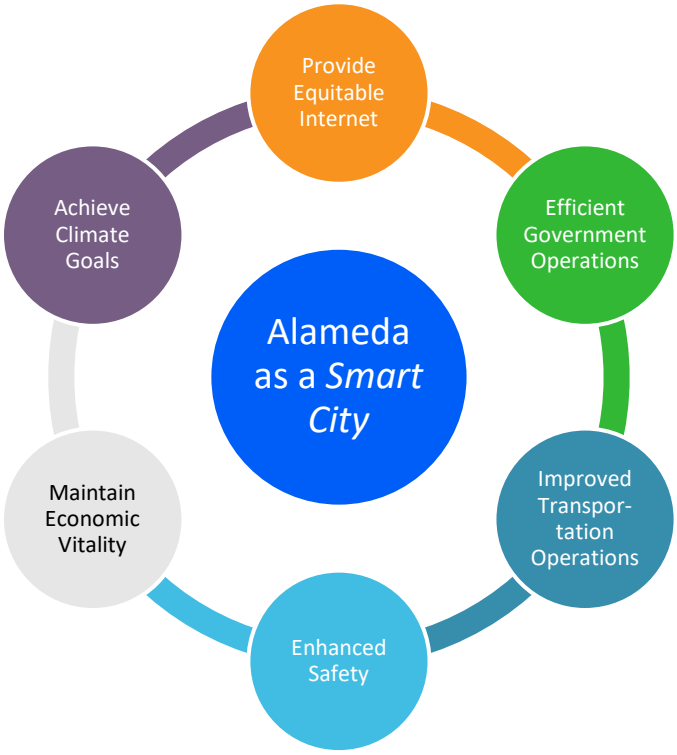


Figure 1: Smart City Master Plan Goals

These high-level goals are also accompanied by key objectives which describe the desired outcome of each of the goals. These objectives will help to define the high-level strategies which will be employed to support the objective and are summarized in **Figure 2**.

Figure 2: Smart City Goals & Objectives

Provide Equitable Internet	•Provide free public Wi-Fi at key City locations •Provide equitable internet access options for all community members including training opportunities •Enhance communications to support expanded bandwidth throughout the City of Alameda facilities
Efficient Government Operations	•Provide more services to residents and staff digitally to enhance City productivity, transparency and engagement with community members •Enhance cyber security measures to protect City and Community information
Improved Transportation Operations	•Improve the transportation efficiencies and safety such as with interconnected traffic signals, real-time public transit information, multimodal detection and data collection, smart parking, streetlights and maintenance •Prepare for the future of transportation technology deployments, i.e., connected and autonomous vehicles •Reduce delay citywide, resulting in more effective traffic flow with improved safety and fewer emissions
Enhanced Safety	•Provide emergency response optimization, disaster early-warning signals, and crash avoidance system capabilities •Enhance security from cyber attacks
Maintain Economic Vitality	•Enhance technology and internet access as well as training opportunities via City programs •Facilitate improved internet service options and improve reliability, speeds, and bandwidth availability
Achieve Climate Goals	•Facilitate telecommuting, tele-school, and telehealth to reduce vehicle trips •Enhance transportation systems and operations to reduce idling and greenhouse gas emissions •Deploy new technologies to improve energy and water efficiencies •Deploy technologies and infrastructure to support monitoring of environmental indicators (e.g., air quality) •Partner with science communities and educational institutions to support climate-specific initiatives

CHAPTER 3: Existing Conditions

In this Chapter

- Documentation of City's Existing Infrastructure which will be utilized and impacted by Smart City initiatives

The City does have existing infrastructure that can and will be leveraged to reach the Smart City goals that were identified in Chapter 2. This Chapter will describe that infrastructure which will serve as a foundation to build the City's Smart City plans upon.

Existing Communications & Technology

This section details the existing communications and technology infrastructure in the City. It provides an inventory of the existing systems and presents a summary of the network protocols and topology used to communicate between the field infrastructure and the various interconnected City facilities (Library, Fire Department Stations, City Hall buildings, etc.).

PREVIOUS SMART CITY INITIATIVES

The City has had other Smart City-related projects in the very recent past. This section describes those projects and their current status.

Webster Street Smart Corridor

The City previously contributed to a Smart Corridor project on Webster Street and Constitution Way, two of Alameda's most travelled corridors and island ingress/egress routes. The project was managed by the Alameda County Transportation Commission (Alameda CTC) and was completed and turned over to the City in 2016. The project included the installation of CCTV cameras, video detection systems, dynamic message signs, microwave detection, and emergency vehicle and transit priority equipment on existing traffic signal infrastructure on Webster Street between the exit of the Webster Street Tube and Central Avenue and surrounding areas. The project included installation of wireless communications via the unlicensed 5GHz wireless radios to facilitate the management of the corridor infrastructure; however, the City does not currently engage the Smart Corridor infrastructure for traffic management, which could be a later project phase. Refer the *Transportation Operations & Emergency Response* section of this chapter and **Figure 7** for additional detail.

Citywide 5G Deployment

As the climate for wireless service changes, many large service providers are actively pursuing opportunities for 5G installations via collocation on public equipment or on public property. In light of that, Public Works staff proactively developed a City ordinance that outlines the permitting, procedure, and design guidelines to support the deployment of 5G equipment in Alameda. Public Works now has an approved master license agreement with Verizon, which would allow Verizon to deploy small wireless facilities on City streetlight poles to enhance 5G coverage. This is currently limited to commercial use by Verizon subscribers/customers.

Lucity Asset Management System

Public Works has deployed over the past several years a comprehensive asset management system where all City assets are logged, tracked, and maintained. The Lucity system is maintained by City Public Works staff and is used to track such assets as, but not limited to, signal equipment, streetlights, and signage. Maintenance of this database is an ongoing task, and it should be noted that all new and potentially existing infrastructure inventoried and/or implemented as part of these Smart City initiatives should be added into that system. A central asset management system such as this allows the City to understand its tools, including geolocations of these resources, and will provide an avenue which will allow the City to fully utilize all assets to their full potential.

DEVELOPMENT-BUILT INFRASTRUCTURE

Alameda is a growing city undergoing new development as the City attracts new businesses and residents. As conditions of development approval of these projects, the City IT department requires developers to install empty conduit to serve future communications needs in the vicinities of the projects, including for deployment of such technologies as those discussed within this Plan. The Public Works department is responsible for enforcing these conditions of approval.

Empty conduits have been deployed in this manner under several development projects in the last several years, including, but not limited to:

- ***Alameda Point*** – Two 2-inch conduits roughly bounding the project along Tower Avenue, Pan Am Way, Midway Avenue, and Saratoga Street.
- ***Webster-Posey Tube Interconnection*** (Caltrans) – One 4-inch conduit along Mitchell Avenue between Mariner Square Loop and Mariner Square Drive east of the tunnel portal buildings as AMP conduit.
- ***2100 Clement*** – Conduit of unknown size and quantity was installed on the project frontage and nearby cross street which is located at Clement Avenue and Willow Street as AMP conduit.
- ***Alameda Landing*** – Conduit of unknown size and quantity was installed in the general project vicinity, which is generally bounded by Fifth Street, Mitchel Avenue, Mariner Square Loop, and Willie Stargell Avenue as AMP conduit.
- ***Del Monte*** – Conduit of unknown size and quantity is planned in the general project vicinity which is bounded by Entrance Street, Clement Avenue, Buena Vista Avenue, and Sherman Street.
- ***Alameda Marina*** – Conduit of unknown size and quantity is currently being constructed north of Clement Avenue between Alameda Marina Drive and Willow Street.

Empty City conduit built as part of these projects and others is depicted on **Figure 4**.

PUBLIC WORKS-BUILT INFRASTRUCTURE

The City's Public Works department also continues to improve infrastructure citywide. Prior to 2020, the City did not have any operational communications in place that supported its signal system. In 2021, Public Works completed an installation of wireless radios along Webster Street, Park Street, and Constitution Avenue. The deployment placed 18 wireless radios along the corridor for wireless communication to support signal timing coordination along these key corridors. Intersections with wireless infrastructure in place are summarized on **Figure 6** and in **Appendix A**.

MUNICIPAL AREA NETWORK

A key partner for the City's technology needs has been Alameda Municipal Power (AMP).

AMP is a power utility company owned by the City that provides electrical power to Alameda residents and businesses. When founded originally, AMP was also intended to be a telecommunications provider and function as an internet service provider so began development of a citywide fiber network. Nevertheless, financial constraints caused AMP to ultimately sell that portion of their business to Comcast. Despite the sale, AMP maintains a private fiber optic network that it uses to manage its own systems and also leases some of the infrastructure to the City for administrative use. The administrative network in use by the City is referred to as the Municipal Area Network (MAN) and is provided to the City at a cost of $80,000 per year. As part of this agreement, AMP provides the technical support and management of the MAN.

Currently, the MAN utilizes AMP fiber infrastructure to interconnect the City's various facilities, which are spread around the City. City buildings are interconnected via four core sites where key network infrastructure is housed. AMP has deployed layer 3 switches at all four core sites and each City facility. The four core sites are located at the City Hall Building 2, AMP's Service Center facility, the Corica Park Golf Course, and City Hall. The network topology is set up as a redundant ring for the core sites and hub and spoke topology for the edge sites. Each of these cores is interconnected with each other via AMP fiber to form a ring and the remaining facilities are interconnected in a spoke configuration via AMP fiber from one of the cores. The MAN network topology is depicted in **Figure 3**. Since the MAN fiber optic infrastructure is managed by AMP, AMP limits the use of that infrastructure due to security concerns as the same fiber optic infrastructure is also used for management of the power systems.

The AMP fiber network is also supported by a network of underground conduits and overhead poles and cabling owned by AMP. This infrastructure may present an opportunity for the City to collocate new communications infrastructure within existing AMP conduits. This opportunity will need to be investigated further, as certain limitations of the AMP communication sales may prevent the City from using the infrastructure for certain uses during a prescribed period of time following the sale. Additionally, it is possible that the City may be able to use conduits which were constructed *following* the sale, which could be explored more with AMP for future communication deployments.

PLANNED PROJECTS

As part of modernization of its system, AMP is in the process of undergrounding its electrical system. About half of Alameda's power system has already been undergrounded since the inception of the program in 1984. The undergrounding projects typically convert overhead wires to underground, install pad-mounted equipment, install updated streetlighting poles, and install a joint trench with other utilities, including City use. Where these undergrounding efforts have occurred in recent years, the City has installed conduit for other City use as part of the joint trench and plans to do so on future undergrounding efforts. This effort includes the installation of conduits for communications interconnect of traffic signals. There is one upcoming undergrounding project on Otis Drive between Broadway and High Street, and on Broadway between Encinal Avenue and La Jolla Drive. Limits of the undergrounding projects are depicted on **Figure 4**.

Figure 3: Municipal Area Network Topology

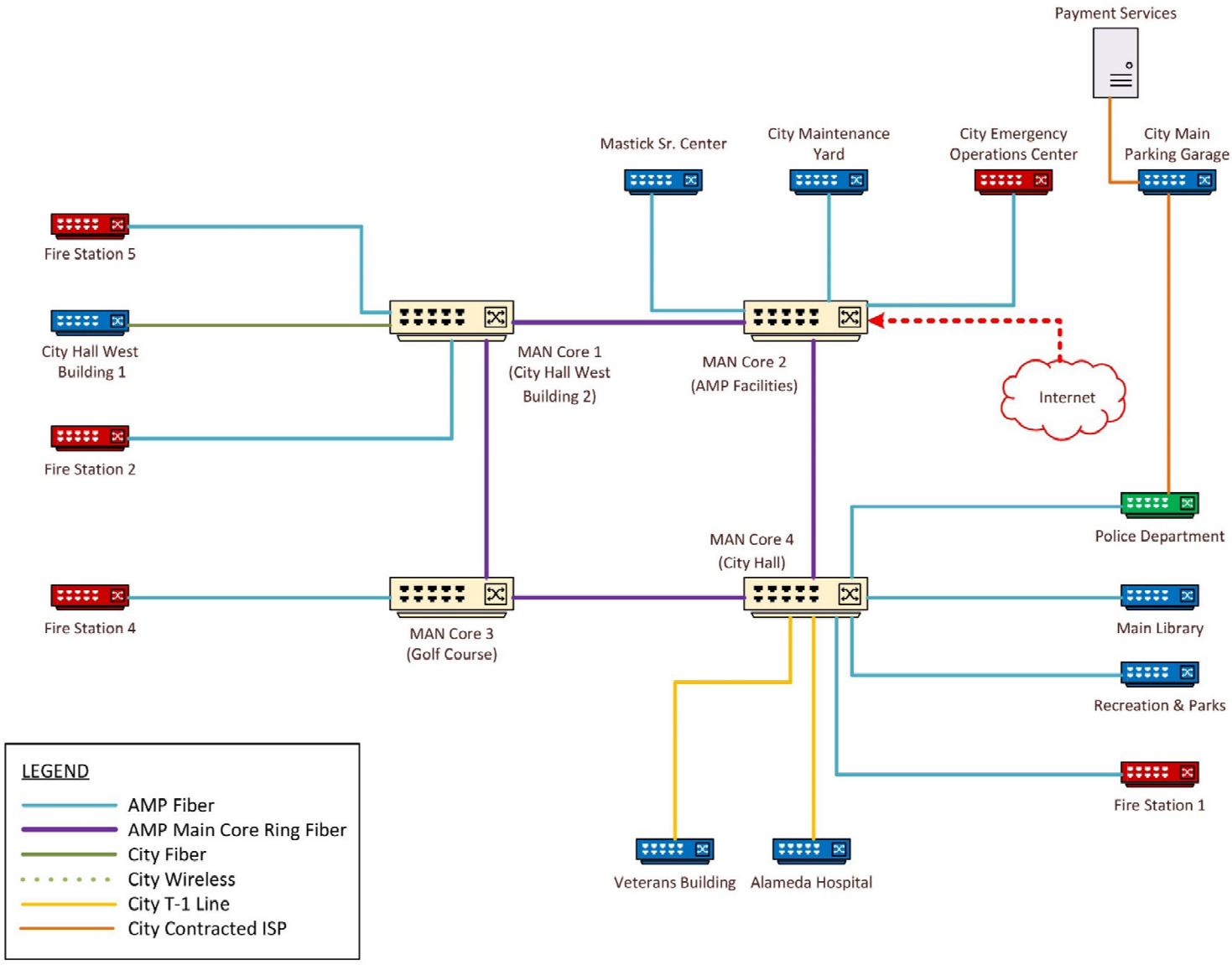
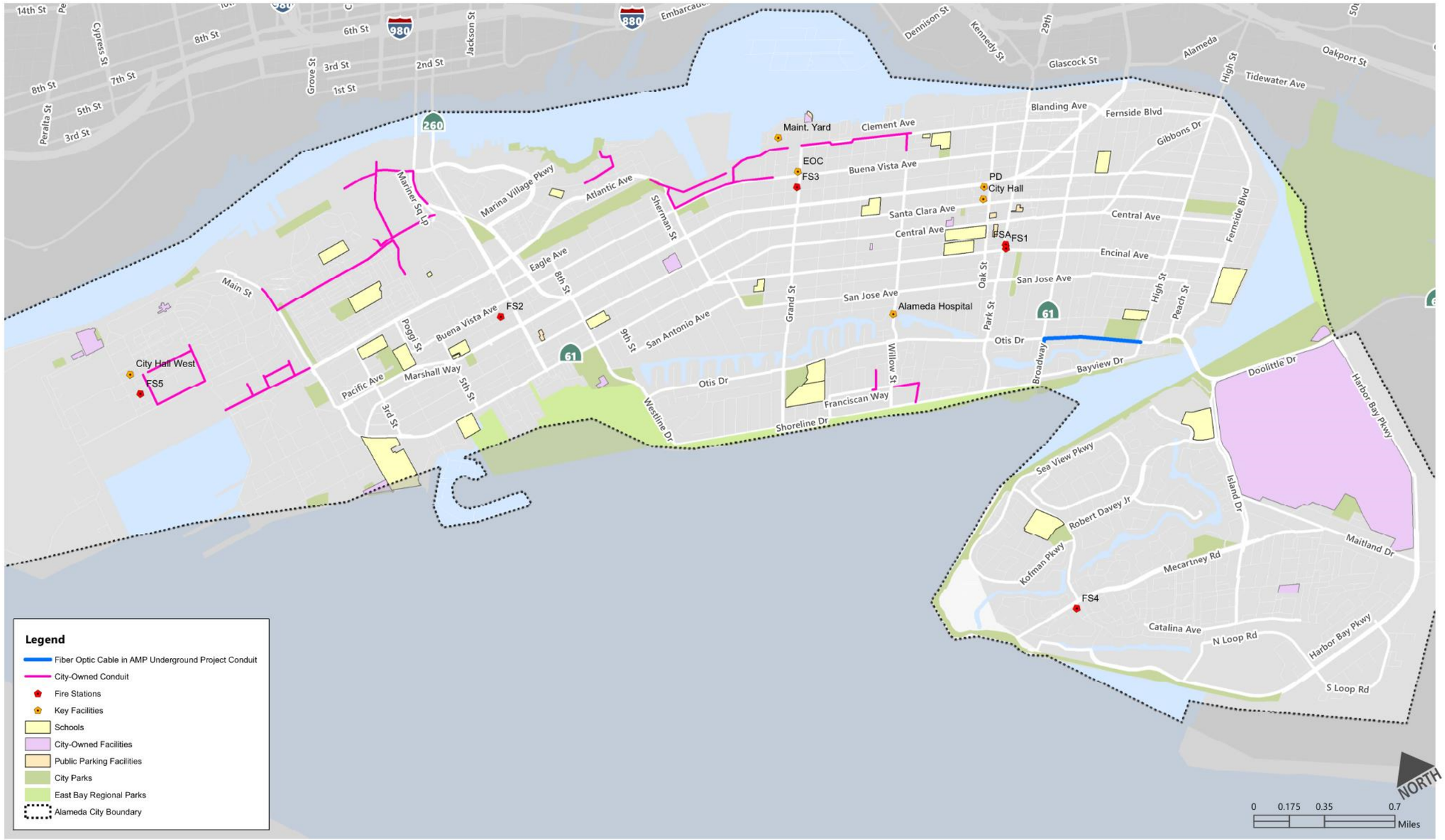


Figure 4: Existing City Conduit Infrastructure



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Transportation Operations & Emergency Response

ROADWAY NETWORK

The City is served by the existing network of roadways, as shown in **Figure 5,** which are defined by the City's 2020 General Plan. The City of Alameda is regionally unique as an island and does not have direct access from any major regional routes such as freeways. Instead, the main island is accessed at several bridge and tunnel access points from the cities of Oakland and San Leandro. Those access points are at the Webster Street and Posey Tubes from Downtown Oakland, via two local bridges at Park Street and Fruitvale Avenue/Tilden Way, and finally via the bridge crossing at Otis Drive/State Route 61 that connects the main island of Alameda to Bay Farm Island. The City's transportation network is comprised of regional arterials, island arterials, and transitional arterials, which are summarized below.

Regional Arterials – Generally wider roadways carrying highest traffic volumes and longest trip lengths which connect Island Arterials and limit traffic in the neighborhoods.

- Atlantic Avenue/Ralph Appezzato Memorial Parkway
- Broadway/State Route 61
- Central Avenue/State Route 61
- Challenger Drive
- Clement Avenue
- Constitution Way
- Doolittle Drive/State Route 61
- East Campus Drive (College of Alameda)
- Encinal Avenue/State Route 61
- Harbor Bay Parkway
- Island Drive
- Main Street
- Marina Village Parkway
- Otis Drive/State Route 61
- Park Street
- Tilden Way
- Webster/Posey Tubes
- Webster Street

Island Arterials – Complementary roadways provided cross-island access for intra-island trips through neighborhoods.

- Central Avenue
- Encinal Avenue
- Fernside Boulevard
- Fifth Street
- Grand Street
- High Street
- Lincoln Avenue
- Main Street
- Marina Village Parkway
- Marshall Way
- Mecartney Road
- Mitchell Avenue
- Otis Drive
- Pacific Avenue
- Robert Davey Jr. Drive
- Santa Clara Avenue
- West Atlantic Avenue
- Willie Stargell Avenue

Transitional Arterials – Roadways which tend to operate as an arterial but are generally desired to operate as a collector, providing access to a nearby arterial.

- Eighth Street
- Blanding Avenue
- Buena Vista Avenue

Figure 5: City of Alameda 2020 General Plan Transportation Element

TRAFFIC SIGNAL SYSTEM

The City maintains and operates 89 signalized intersections, which are depicted on **Figure 6**. The City does not currently use a centralized Advanced Traffic Management System (ATMS) for management and monitoring. All of the City's signals utilize several types of Econolite controllers including ASC/2S, ASC/3, ASC/3S, and Cobalt. The City has standardized on the use of the Econolite Cobalt controller for any future updates or new signals. The 89 signals' equipment ranges in age and condition, and most intersections run independently. The signals use a mixture of inductive loops and video detection, and there are intersections with no active detection which operate with fixed timing. Refer to *Operations* section of this Chapter for additional operations information.

The City has deployed NEMA Type P, Type G, and Caltrans 332 cabinets throughout the City. The signals with NEMA Type P and 332 cabinets are generally accompanied by Type III service pedestals. Type G cabinets typically have cabinet mounted meters. For NEMA cabinets, the City has standardized on the use of NEMA TS-2 cabinets. About 35 intersections have battery backup systems installed. Battery backup systems can provide the power needed to run an intersection when transmission power is lost to the cabinet.

Some of the disconnected and outdated traffic signal technology problems can be solved by removing the traffic signals altogether and replacing them with roundabouts, which the City Council has approved for Main Street/Pacific Avenue/Central, Third Street/Taylor Avenue/Central Avenue, Encinal Avenue/Sherman Street/Central Avenue, Fourth Street/Ballena Blvd/Central Avenue and Grand Street/Otis Drive intersections. City staff is in the process of analyzing other potential locations throughout the city for roundabouts to replace traffic signals.

TRANSIT PRIORITY & EMERGENCY VEHICLE PREEMPTION SYSTEMS

The City does not currently operate traffic signals with Emergency Vehicle Preemption (EVP). While a number of signalized intersections are equipped to provide EVP, there are currently no equipped emergency vehicles (i.e., fire trucks) that are equipped to use this infrastructure at the intersections. The City does have a small number of operational transit signal priority (TSP) that have been deployed by AC Transit along the Line 51A bus route. The Webster Street Smart Corridor project also deployed EVP equipment at several corridor intersection. The newer GPS-based equipment installed at the intersections are capable of functioning to provide both EVP and TSP operations. Intersections outfitted with TSP/EVP are depicted on **Figure 6** and summarized in **Appendix A**.

PARKING MANAGEMENT

The City currently manages four parking facilities. Three of the facilities are surface lots. The fourth facility is a parking structure near the Civic Center which includes a parking payment system. The lot is interconnected to the Police Department via two internet connections: a 1GB wireless Comcast connection for internet connectivity and a 20MB AT&T connection for the pay systems and parking space presence system. City-managed surface lot parking is served by credit-card capable parking meters. Parking enforcement is currently provided by the City of Alameda Police Department. In addition to interconnection to the facility via the MAN, the parking structure has a direct 1G connection to the Police Department that supports the surveillance camera system. There is also a separate independent connection for the City's Parking Management System for payment processing. The City's parking facilities are shown on **Figure 6**.

In the past, the City had explored the possibility of deploying a license plate recognition system for parking enforcement. However, this

proposed system raised some privacy concerns within the City and has not yet been advanced. Additional information on privacy concerns within the City are discussed in the *Security & Privacy* and *Cyber Security* sections of Chapter 4.

ITS INFRASTRUCTURE

As previously discussed in the *Previous Smart City Initiatives* section of this Chapter, the City's previous Smart Corridor project deployed several Intelligent Transportation System (ITS) elements along the project corridors of Webster Street and Constitution Way. These elements included five (5) CCTV cameras, three (3) dynamic message signs, and five (5) microwave detection locations. These ITS elements are shown on **Figure 7**.

OPERATIONS

Generally, the City's signalized intersections operate in an uncoordinated timing mode. That is, the traffic signals operate as independent intersections and do not coordinate their operation relative to how adjacent signals operate. The City uses limited coordination timing plans between intersections due to communication limitations. Nevertheless, the City has recently begun implementing wireless communications infrastructure on Webster and Park Streets to support a coordinated corridor. Those coordination plans are in development at the time this document was prepared.

The City does not currently have citywide equipment that is actively collecting data around the City. The lone exception is at the Alameda Trail crossing between Webster Street and Fifth Street where Public Works is collecting pedestrian and bicycle data. This data is collected and accessible via a cellular connection. Furthermore, the City has begun deployment of some equipment - video detection systems, controllers - that is capable of collecting high-resolution data; however, a comprehensive monitoring program or system has not been implemented. Thus, the videos only are used to place detection calls to the controllers so the City is not identifying people or license plates with this system. Though the City is not collecting data at this time, Alameda County Transportation Commission (Alameda CTC) does collect pedestrian and bicycle data as part of CMP monitoring in Alameda.

Figure 6: Existing City Facilities and Traffic Signal Infrastructure

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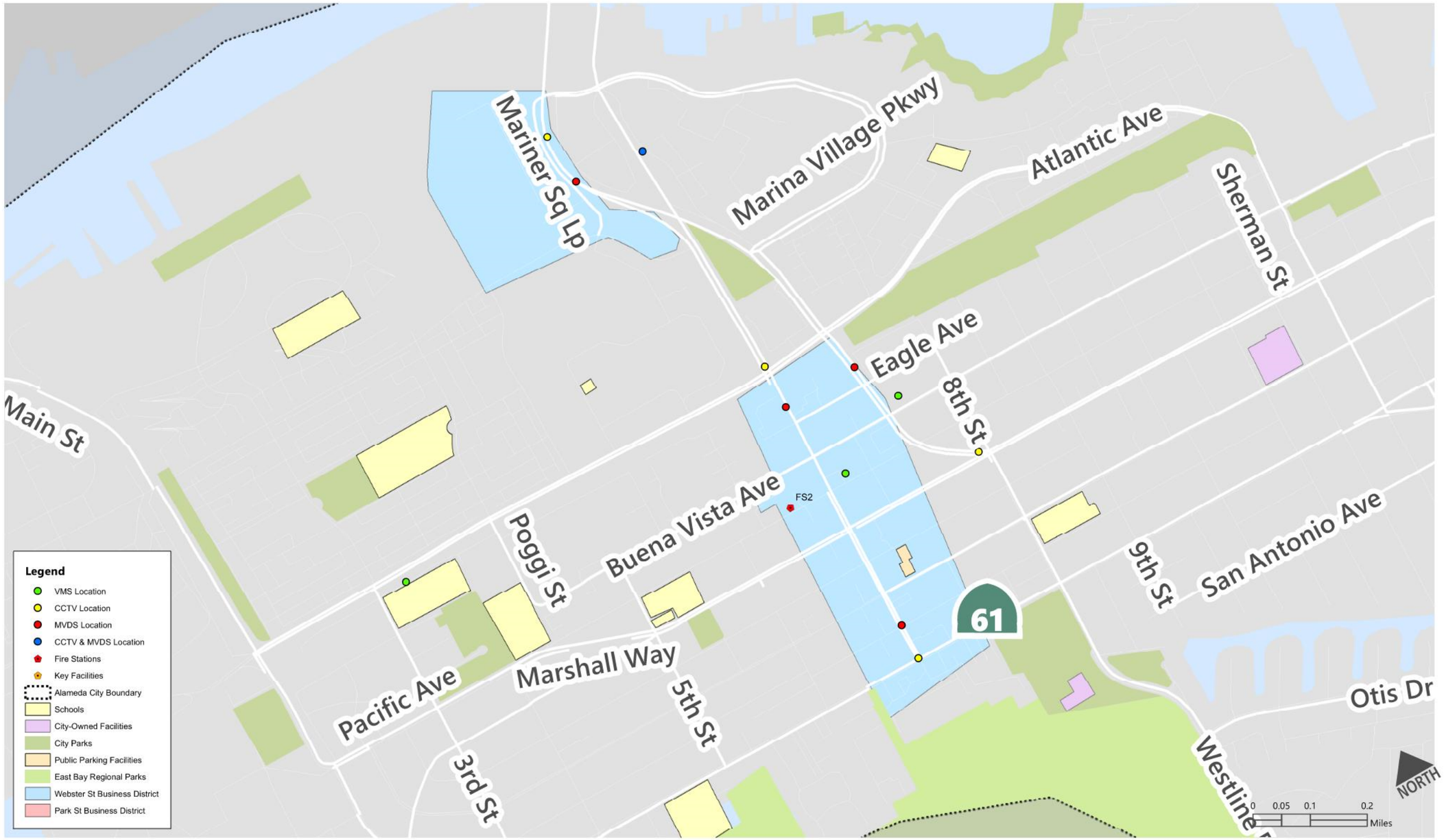
Figure 7: Existing ITS Elements



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City Facilities & Operations

The City's existing facilities will play a very key role in the rollout of Smart City technology. The City maintains a variety of public service buildings and facilities, and also partners with other City and governmental agencies to assist with meeting technological needs.

CITY ADMINISTRATIVE BUILDINGS & PUBLIC FACILITIES

The City maintains several administrative buildings that are interconnected via the Municipal Area Network (MAN) as discussed in the *Municipal Area Network* section of this Chapter. Key city buildings are summarized in **Table 1,** and locations are depicted on **Figures 4** and **6**. Each facility that is part of the MAN is equipped with a Cisco 3760 Layer 3 switch for managing the City's administrative networking needs.

Table 1: Key City Facilities

Facility	Address	Interconnection Via
Mastick Senior Center	1155 Santa Clara Avenue	MAN
Maintenance Yard and Building	1616 Fortmann Way	MAN
Civic Center Parking Garage	1416 Oak Street	1G connection to the Police Department for surveillance, and independent U-verse connection for payment processing
Emergency Operations Center	1809 Grand Street	MAN
Fire Station 1	2401 Encinal Avenue	MAN
Fire Station 2	635 Pacific Avenue	MAN
Fire Station 3	1625 Buena Vista Avenue	MAN
Fire Station 4	2595 Mecartney Road	MAN
Fire Station 5 (temporarily closed)	950 West Ranger Avenue	MAN
City Hall West Building 1	950 West Mall Square	MAN
Main Library	1550 Oak Street	MAN
Recreation and Parks	2226 Santa Clara Avenue	MAN
Alameda Police Department	1555 Oak Street	MAN
Corica Park Golf Course	1 Clubhouse Memorial Rd	MAN
City Hall	2263 Santa Clara Ave	MAN
City Hall West Building 2	950 West Mall Square	City Fiber to City Hall West Building 1
Veteran's Memorial Building	2203 Central Ave	T-1 To City Hall
Alameda Hospital	2070 Clinton Ave	T-1 to Fire Station 1

INCIDENT RESPONSE & ROUTES

In 2019, the City completed an Emergency Operations Plan to address disaster response and recovery operations for the City of Alameda. The document reviews how the City will implement the California Emergency Services Act in the event of an emergency affecting Alameda and its residents, employees and visitors. The main purpose of the plan is to define the City's responsibilities during an all-hazards emergency response and includes details on policies and procedures, structure and operation of the City's Emergency Operations Center, details for training and response exercises to ensure compliance, and compliance information and guidance for National Incident Management System according to the National Response Framework, Standardized Emergency Management System, Incident Command System, and the State of California Emergency Plan. This plan includes additional detail meant to be enacted in the event of hazards which the City is particularly vulnerable, such as earthquakes, flood and tsunami, extreme heat, drought, and civil emergencies, and provides guidance on preparedness, response, recovery, and mitigation of these hazards.

In addition to the City's Emergency Operations Plan, the City is participating in a regional effort to improve safety and evacuation information sharing regionally via a tool called Zone Haven. Zone Haven provides a subdivision of an agency's area into zones which can be used for evacuation planning in the event of the aforementioned emergencies. This effort is generally managed by the Fire Department. Zone designations, which are managed internally by the City, are visible to the public, enabling all users, whether residents or visitors, to be able to access evacuation or public safety threat information (including wildfires). The City is currently finalizing the definition of the zones in Alameda and will begin participation in the Zone Haven information system upon completion. This system is in use regionally in Contra Costa County, San Mateo County, and Santa Cruz County.

In addition to Zone Haven zoning, the Fire Department also manages its emergency response in several districts. Alameda is currently served by five engine response districts, 2 truck response districts, and three medic/ambulance response districts. Each of the districts is also designated backup for adjacent districts, which is managed and called upon based on the severity of the incident and availability. The Department also uses several other vehicles and teams that cover the entire City limit. The area of responsibility for each response district is summarized in **Table 2**. The City of Alameda also provides mutual aid to adjacent jurisdictions such as Oakland and San Leandro, and also receives mutual aid, as needed for more substantial incidents.

Table 2: Public Safety Response District Details

Response District Name	Limits of Coverage
Engine Response Districts	
Engine 1	Willow Street, both sides, east to Bay Farm Island Bridge (not including)
Engine 2	Kingsbury Ct./Triumph Dr./St. Charles St./Larchmont Isle/Shell Gate Rd. (not including) to 100 block Central Ave., the 1700-1900 blocks of Main St. (both sides), and Ralph Appezzato Memorial Pkwy. (both sides) east from Main Street including the Bayport Development, the College of Alameda, the Naval Supply Annex, Mariner Square Loop, Wilver "Willie" Stargell Ave. and Mariner Square Dr. to the Oakland-Alameda Estuary and Engine 5 District as follows: Alameda Point, both sides of Main Street north from, Ralph Appezzato Memorial Pkwy. inclusive of all streets and housing areas accessible from Main St. by Singleton Avenue.
Engine 3	Kingsbury Ct./Triumph Dr./St. Charles St./Larchmont Isle/Shell Gate Rd. (both sides) to Willow St. (not including).
Engine 4	Bay Farm Island and all of Bay Farm Island Bridge.
Engine 5 (Temporarily closed, but this region is covered by Engine 2)	Alameda Point, both sides of Main Street north from Ralph Appezzato Memorial Pkwy. inclusive of all streets and housing area s accessible from Main St. by Singleton Avenue. Truck Unit Response Districts
Truck Response Districts	
Truck 1	Grand St. (both sides) east to include Bay Farm Island.
Truck 2	Grand St. (not including) to the west end
Medic/Ambulance Response Districts	
Medic 1	Grand Street (including) east to the Bay Farm Island Bridge (not including).
Medic 2	Grand Street (not including) west to all of Alameda Point.
Medic 4	Bay Farm Island Bridge (including) and all of Bay Farm Island.

OTHER CITY SYTEMS

The City has several other types of equipment deployed around the City, some of which are in need of upgrade or remote management capability and are managed by the Alameda Recreation and Parks Department (ARPD). These ARPD systems include athletic field lighting, restroom locks, irrigation controllers, and building security and access systems.

Currently, the only systems managed remotely are irrigation controllers, which are accessed via a cell phone connection. Additionally, several of the facilities managed by ARPD do not have dedicated City communications in place and utilize hot spots or cellular connections for system and internet access, which is inconsistent and low bandwidth. Many of these ARPD public facilities are also not equipped appropriately for public Wi-Fi and cash payment

management, and do not have security measures, such as cameras, in place to help protect City assets.

Furthermore, Public Works Department has a Supervisor Control and Data Acquisition (SCADA) system for the pump stations. The SCADA system monitor's the City's system and provides remote access and control to Public Works staff. The SCADA system server equipment is located at the Maintenance Service Center and is maintained by City IT staff.

SECURITY & PRIVACY

Security and privacy are very important concerns in the City of Alameda. Historically, the City has not used certain technologies (e.g., facial recognition, video monitoring or recording) due to the various privacy implications of gathering data from the general public. The City adopted a resolution (No. 15625) prohibiting the use of face recognition technology and setting forth the City's policies for data management and privacy in December of 2019. The resolution defines the City's responsibility as it relates to the management of the public's personal data. The City has also been considering the use of drone technology for monitoring inaccessible areas (e.g., fire damaged areas, or unsafe facilities) and even commercial use. At this time, the City is considering what this will mean for Alameda residents, business, and visitors, and continues to monitor the FAA's regulation of the devices, which may result in stricter policies due to Alameda's close proximity to the Port of Oakland and Oakland International Airport.

Additionally, the City has recently considered the implementation of Automated License Plate Reader (ALPR) technology for law enforcement and for possible parking enforcement. The Alameda Police Department does have existing policies governing the implementation and use of ALPR technology, which includes the provision for privacy protection and appropriate use of the system. As a department of the City, the Police Department is also subject to the requirements described within the City Resolution No. 15625.

As of January 2020, the City of Alameda is also subject to the provisions of Proposition 24, which was passed into Law by California voters. Proposition 24 amended the existing California Consumer Privacy Act (CCPA) with additional requirements and is called the California Privacy Rights Act (CPRA). Generally, the CCPA gave consumers the power to control how collection of their data occurs and allows them to access and manage their privacy preferences. CPRA amended the CCPA to place a portion of the responsibility on the collectors of the data, requiring that data collection be minimized where possible, retention be limited, and any retained data be sufficiently protected.

CYBER SECURITY

The City of Alameda is also very focused on maintaining the security of its digital systems from cyber threats. Realizing that many agencies and government entities have fallen victim to hackers and cyber criminals, the City has taken steps to implement a Cloud First policy which places the City's critical systems outside of the City's physical premises. This policy enables the City IT department to effectively react in the event of an emergency or disaster which may affect the island or parts of the island. This is consistent with the City's Disaster Preparedness goals and the Information Technology Strategic Plan. As part of the Smart City efforts, abiding by the City's cyber security policies and practices will be key to ensuring the City's systems are protected.

Equitable Internet & Economic Vitality

The City of Alameda is very closely tied with their citizen and business communities via several key institutions and organizations.

ALAMEDA UNIFIED SCHOOL DISTRICT

As a result of the COVID-19 pandemic beginning in 2020, many of Alameda's internet inequities regrettably came to light as schooling shifted to distance learning, and the provision of internet outside of school is now an essential part of teaching and learning during the pandemic and beyond. The Alameda Unified School District currently owns 23 school facilities in Alameda, which are summarized in **Table 3** and shown on **Figures 4** and **6**.

Table 3: AUSD School Facilities

Facility Name	Grade Level	Address
Alameda Adult School	Adult	2201 Encinal Avenue
Alameda High School	9-12	2200 Central Avenue
Alameda Science and Technology Institute	9-12	555 Ralph Appezzato Pkwy
Amelia Earhart Elementary School	TK-5	400 Packet Landing Road
Bay Farm School	K-8	200 Aughinbaugh Way
Chipman Site for Academy of Alameda	K-8	401 Pacific Avenue
District Office	Administrative	2060 Challenger Drive
Edison Elementary School	K-5	2700 Buena Vista Avenue
Encinal Junior & Senior High School	6-12	210 Central Avenue
Food Service Warehouse	Food & Nutrition Services	2130 Clement Avenue
Franklin Elementary School	K-5	1433 San Antonio Avenue
Island High School	Continuation 9-12	500 Pacific Avenue
Lincoln Middle School	6-8	1250 Fernside Boulevard
Love Elementary School (formerly Haight School)	TK-5	2025 Santa Clara Avenue
Maya Lin Elementary School	K-5	825 Taylor Avenue
Otis Elementary School	K-5	3010 Fillmore Street
Paden Elementary School	K-5	444 Central Avenue
Ruby Bridges Elementary School	TK-5	351 Jack London Avenue
Singleton Maintenance Yard	Maintenance of Facilities	250 Singleton Avenue
Thompson Field	Sports Field	1800 Walnut Avenue
Wood Middle School	6-8	420 Grand Street
Woodstock Child Development Center	Pre-School	500 Pacific Avenue
Woodstock Site for Charter Schools ACLC/NEA	TK-12	1900 Third Street

AUSD services approximately 9,600 students across its TK-12, pre-school and Adult School programs. The schools offer a wide range of services in addition to traditional learning, which necessitates specific technology support and reliable and robust internet facilities. As a result of the pandemic, AUSD was forced to shift its approach for internet availability from school-based to home-based learning. Because the needs of students vary greatly, and Alameda already suffered from diminished internet availability, AUSD elected to deploy over 400 cellular hotspots to students. Generally, this approach did work but presented a fairly large cost burden on the district. An additional challenge that was faced was providing sufficient technical support for the hotspots and also ensuring appropriate use of the hotspots (i.e., limiting use to school and disallowing personal use). This approach, though it solved the short-term need in the face of the pandemic, has been acknowledged as not

solving the underlying problem of internet availability to all AUSD students. Also, as a result of this rollout, the City and AUSD were able to identify areas in Alameda that appeared to be weaker on internet availability and/or reliability based on where students with hotspots were located.

In addition to the hotspots, AUSD has deployed over 5,000 Chromebook laptops to students. Support for these laptops faced several issues as well, including the need for technical support for parents and students as distance learning became the main vehicle for the 2020/21 school year. As AUSD has plans to institute requirements that students use school-owned technology for schoolwork, this consideration for sufficient service support has become a top priority.

The District has a hardwire fiber connection between each school and the District Office at 2060 Challenger Drive, using AT&T's Switched Ethernet On Demand (ASEoD). Speed between the schools and the District Office are between 1Gbps and 2Gbps. The connections show a bandwidth usage of between 5 percent and 50 percent and have been reported as satisfactory. The district uses Alameda County Office of Education (ACOE) as its internet provider. The service is partially funded by the eRate and routed through Alameda County Office of Education (ACOE) to the K12 High Speed Network (K12 HSN network). The internet connection between the District office and ACOE is 5Gbps and combines access to the internet for all schools.

AUSD manages local area networks between classrooms and buildings on each campus and has outfitted each classroom, as well as some public areas such as parking lots, with a wireless access point. This network, which is managed by AUSD's IT Department, is currently only used internally. The District uses Hewlett Packard equipment for communications and is generally pleased with their current level of communications.

EQUITY PRIORITY COMMUNITIES

The Plan includes the need for more equitable internet access to address the "digital divide" that currently exists and that was exacerbated with the pandemic. Several City facilities offered internet access services for low-income families, homeless, and seniors. To provide these services, the City has maintained computer labs at the Mastick Senior Center and the Alameda Main Library. Additionally, there are several other public locations like the Boys and Girls Club that offer similar services. To support users of these computer labs, the Recreation and Parks Department has offered computer literacy training and there is a number of other self-serve, private and free options that are prescribed to those who inquire such as in person literacy training at Alameda Adult School or internet coaching by students and community service individuals. Due to pandemic regulations, many of these facilities have been temporarily closed, leaving these groups underserved, and most of the support services have been temporarily discontinued as well, resulting in reduced internet access and literacy among these equity priority populations in Alameda. It is also important to note that a higher concentration of these issues occur in the west end of Alameda where a higher proportion of the vulnerable population is located. Continued availability and expansion of these services may be subject to specific cybersecurity vulnerabilities which the City is in the process of considering.

ECONOMIC VITALITY

Businesses in Alameda have not been immune to access issues as well. Businesses in Alameda play a key role in the City's economic resiliency, and a key ingredient to their success is access to the internet. Internet services for businesses provided by the available private ISPs are reported to be less than satisfactory, with low bandwidth availability, mediocre speed, and high prices. Businesses are also at times subject

to tenant allowances that might hinder their ability to make building improvements to improve internet access. Furthermore, there is a lack of public wi-fi in our business districts.

Businesses require dependable, affordable internet access to simply conduct business. Systems such as phone, POS systems, security systems, maintaining an online presence, website maintenance, and basic communications such as email, social media and video conferencing are dependent on reliable access to the internet. Additionally, having the ability to provide free public wi-fi to visitors would create a welcoming environment and encourage visitors to fully enjoy the experience as well as the many amenities available.

With the increase in telecommuting and need for running business remotely as a result of the pandemic, the issues became more apparent. The City's Climate Action and Resiliency Plan (2019) promotes telecommuting as a key strategy to reduce greenhouse gas emissions in that 70 percent of Alameda's GHG emissions are from transportation. Residential neighborhoods for the residents who telecommute from home in Alameda also have low bandwidth and lack reliable internet, which will be important to improve so as to meet the City's goals around reducing off-island commute via single occupant vehicles.

Regional Interconnection

The City of Alameda is not currently interconnected with any of its regional agency partners. Nevertheless, there are several possibilities with the City of Oakland, Caltrans, and San Leandro. A notable example is the City of San Leandro's Lit San Leandro ISP effort. Lit San Leandro provides affordable internet services to businesses via a citywide fiber optic network which incidentally is located adjacent to the City of Alameda's Bay Farm district. Interconnection with surrounding cities like San Leandro would provide an important capability for real-time data sharing from traffic infrastructure (e.g., cameras, signal controllers, etc.), especially the sharing of key traffic data to assist in improving traffic performance and continuity of services across city limits.

Community Science – CENIC

The City is currently partnering with the non-profit organization California Research and Education Network's high-capacity computer network called CENIC. The CENIC network is a global scientific research network that serves students, educators, and researchers to support the public good. The network is focused on providing robust data collection dedicated to education and research in the area. The City currently has a wired fiber connection at MAN Core Site 1, which is located at City Hall West building 2, adjacent to building 1 where a wireless radio connection can communicate with autonomous ocean vehicles deployed in the Bay by Saildrone. This system has not yet gone live but is ready for use. To support this effort, the City has entered into a settlement-free interconnection (SFI) agreement with CENIC, which allows a direct interconnection with Alameda and Contra Costa County schools, NOAA, and Berkeley Lab. The City also has a community program in development to place sensors at Seal Point to count the number of seals on the seal float. The data collected will be analyzed to conduct environmental studies.

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CHAPTER 4: Needs & High-Level Requirements

In this Chapter

- Identification of stakeholders involved in the development of this Plan.
- Summary of identified needs of the various stakeholders.
- Association of needs to Smart City objectives.

Stakeholders

This section provides a summary of the various stakeholders involved in the development of the Smart City Master Plan document. As part of the needs assessment process, City staff and Iteris conducted a number of outreach meetings with key city departments, educational institutions, neighboring agencies, and local community and business organizations. The key stakeholder focus group meetings helped the City staff and Iteris better understand the needs of these members and how technology and communications solutions could potentially help address these needs.

CITY DEPARTMENTS

The City of Alameda is comprised of many different departments which serve multiple functions for City business and resident services. For this plan, the following City departments were consulted to review their existing infrastructure and operations, as well as assess their current and projected needs as it relates to the City's Smart City goals.

- Public Works
- Information Technology
- Transportation Planning
- Alameda Municipal Power
- Recreation & Parks
- Public Safety
- Economic Development

LOCAL INSTITUTIONAL, BUSINESS, AND COMMUNITY ORGANIZATION

In addition to the City's key department stakeholders, various institutional, business, and community-based organizations were also included. These groups also contributed to shaping the overall vision of the City's Smart City goals, which aim to address widespread equitable access issues in Alameda and to serve the City's growing business needs. The following groups were included in the needs assessment:

- Key Business Groups
  - Alameda Chamber of Commerce
  - West Alameda Business Association
  - Downtown Alameda Business Association
- Key Institutional Groups
  - College of Alameda
  - Alameda Unified School District
  - Community science: CENIC and community volunteers
- Equity Priority Community Service Groups
  - Alameda Educational Foundation
  - City Paratransit
  - Alameda Family Services
  - Mastick Senior Center (via Recreation & Parks)
  - Alameda Point Collaborative
  - Alameda Housing Authority

REGIONAL PARTNERS

Finally, to continue to partner well with the City's neighbors, several regional public agency partners were introduced to the City's Smart City initiatives and asked for their feedback. Partnering with other public agencies operating within and adjacent to Alameda will offer a more seamless regional technology experience, and also offers Alameda a chance to learn about similar initiatives neighboring agencies may be implementing. The following regional partners were also invited to contribute to this Master Plan:

- AC Transit
- City of San Leandro
- City of Oakland
- Telecommunications providers

Needs Identification

The needs assessment presented in this section includes discussions with the various stakeholders. Meetings with stakeholders were primarily conducted during January and February 2021, with a follow-up meeting with Public Works conducted in June 2021.

The following tables summarize the specific needs from the various stakeholders provided during each of the needs assessment meetings. For each stakeholder, a table is provided that summarizes their needs and the related Smart City objective(s) to be achieved which addresses that need.

Table 4: Transportation Needs Summary

Need	Objective
Robust communications network that interconnects signalized intersections in Alameda, including future planned signals	Improve operational efficiencies for managing traffic signal infrastructure and provide mechanism for Public Works to manage signal infrastructure remotely
Centralized traffic signal control and monitoring	Improve operational and maintenance efficiencies within the City and provide mechanism for Public Works and City Traffic Engineer to manage and monitor traffic signal infrastructure remotely
Continue to implement advanced traffic management strategies and technologies (e.g., adaptive signal control, TSP, EVP, etc.)	Reduce signal maintenance and incident management workload, improves public safety, improves transit service and reliability
Provision for enhanced multi-modal data collection at all City intersections (i.e., vehicle counts, speed data, pedestrian and bicycle counters, origin-destination surveys, congestion management tools)	Enable City Transportation Planning and Public Works staff to make well-informed decisions to develop and improve the city's transportation network, including facilitating system performance measurement and an open data portal so that the public and partners can access data and develop "civic tech" applications and engagement
Support technology deployment for City parking facilities (e.g., mobile payment solutions, wayfinding)	Automate parking management and payment services to reduce workload needs for parking services
License Plate Recognition (LPR) system for parking enforcement	Enhance automated parking enforcement
Support future Connected Vehicle/Automated Vehicle (CV/AV) technologies	Prepare the City for the expanding CV/AV needs in the region
Deploy roadway CCTV monitoring system	Enhance remote transportation network monitoring and incident management capabilities while protecting privacy in that it will not be used as a surveillance or tracking system

Table 5: Public Works Needs Summary

Need	Objective
Shift more City services online and continue to digitize documents	Improves public access to services without need to visit City offices
Institute methods like micro-trenching for development underground installations	Reduce impact on existing infrastructure during construction
Develop policies and standards that ensure development projects contribute to communications network buildout	Ensure development in the City is consistent with City infrastructure goals and objectives
Support City's infrastructure asset management system needs	Enable improved remote asset management and aid in protecting and maintaining City's various infrastructure and fleet assets
Support City's planned fleet telematics (AVL) deployment	Enable improved remote fleet management and aid in protecting and maintaining City's fleet assets
Improve coordination with utility agencies for joint trenching/boring opportunities	Reduce impact on existing City infrastructure and enhance relationship for future improvement opportunities
Enhance City building operations and maintenance with automation and monitoring systems (HVAC, access, mechanical systems, etc.)	Provide remote monitoring and management capabilities to reduce staff workload to maintain various building systems
Continue to improve remote capabilities of City's SCADA system to allow for improved remote lagoon and pump station management	Provide remote monitoring and management capabilities to reduce staff workload for pump station and lagoon management
Develop or acquire utility monitoring dashboard technology to engage smart infrastructure for monitoring utility use (power, water, etc.)	Inform City financing of utility systems and provide real-time status monitoring of all utility usage citywide
Continue to enhance air quality monitoring capabilities (indoors and outdoors)	Improve air quality reporting capabilities to better inform City partners and residents, especially during California Wildfire season

Table 6: Information Technology (IT) Needs Summary

Need	Objective
Independent municipal network managed by City IT	Allow IT to manage and scale network to meet City needs without restrictive limits currently imposed by utility regulations.
Connect all of City's existing communications facilities on City-owned communications network	Enable seamless management and scalability of bandwidth of City's facilities to meet ever changing needs
Establish EOC as the hub of communications in the City	Provide City with a centralized management point for all systems to enhance management and maintenance, including during emergencies
Firewall management to separate City and AMP infrastructure, as well as intra-City and public access to City network	Protect City network assets and systems from malicious entities, provide secure and separate system solely for City administrative use, as well as a separate secure public network to enhance digital equity
Establish a secured network perimeter for City's internal network connection	Protect City network assets and systems from malicious entities
Consider interconnection to Digital Realty Trust (DRT) data center in Oakland (Tier 1 data center)	Expand City's access to global resources and cloud services
Sensitivity to public privacy (compliance with City's Privacy policies)	Maintain City's commitment to protect privacy for all users, especially residents
Establish robust cyber security protocols and policies	Protect City network assets and systems from malicious entities

Table 7: Alameda Municipal Power (AMP) Needs Summary

Need	Objective
Clear separation between AMP and City's communications infrastructure to ensure compliance with previous agreements	Provide greater autonomy, enhanced service features, and enable City IT to manage their own infrastructure
Separate out the proposed City communications fiber network from AMP electricity network	Split the network since AMP has stricter telecommunications regulations for equipment controls and network security for the electricity grid

Table 8: Recreation & Parks Needs Summary

Need	Objective
Remote management systems for lighting, facility security, and irrigation	Improve efficiencies within the Recreation & Parks and provide mechanism for city staff to manage Rec & Park infrastructure remotely, reducing workload on existing staff
Internet access at park facilities, such as the Gym	Provides broadband internet service for city staff and users at facilities that lack this service

Table 9: Public Safety Needs Summary

Need	Objective
Infrastructure to support Zone Haven efforts for evacuations	Improve City's and Public Safety's ability to communicate to its residents during emergencies, and especially during evacuations
Emergency Vehicle Preemption (EVP) city-wide and on Public Safety vehicles	Enhance Public Safety response time to emergencies by providing safe, clear travel routes for first responders
Establish notification system that alerts Fire Department of bridge raisings that may impact response routes in real-time	Inform fire department of real-time traffic impacts to emergency vehicle routing
Revised emergency response routing coordination as a result of street narrowing projects or construction activity	Continue to provide sufficient emergency response coverage in conjunction with other City efforts to build safer streets
Continue to provide public safety communications network that are compliant with Department of Justice (DOJ) security requirements	Maintain DOJ-compliant systems to supplement Public Safety goals and objectives
License Plate Recognition (LPR) system for police enforcement	Enhance automated law enforcement

Table 10: Economic Development Needs Summary

Need	Objective
Reliable internet options in the Business Districts	Attract diverse businesses and industries to Alameda to enhance economic vitality
Public Wi-Fi in incentive areas such as downtown areas	Attract consumers and business to these areas to enhance economic vitality
Redundant internet infrastructure, perhaps with added nodes on public property (i.e., 5G nodes at intersections on City poles)	Partner with ISPs to support growing bandwidth need, including cellular needs of visitors, businesses, and residents
Enhanced cyber security measures on public networks	Protect City network assets and systems from malicious entities

Table 11: Educational Institutions & Equity Priority Populations Needs Summary

Need	Objective
System capable of facilitating an anticipated need for continued distance learning, telecommuting, and telemedicine in the future	Ensure networks are sufficient for expanding bandwidth needs including coordination with private ISPs
All homes with access to the internet, including multi-family	Expand high speed and reliable internet access availability to bridge digital divide
Establish policies and provisions for current prohibitive internet installations, such as within leased/rented multi-unit buildings	Encourage digital equity citywide
Robust technological support for all users	Encourage digital equity citywide, especially for equity priority populations (e.g., seniors, unhoused, low-income, etc.)
Access to power for charging devices for unhoused and equity priority populations	Enable equitable access to technology for all
Wi-Fi on AUSD campuses and off-campus at public gathering centers (i.e., Boys and Girls Club, Alameda Point Collaborative Learning Center, and Recreation & Parks facilities)	Expand reliable internet access availability to bridge digital divide
Provision for technology and internet literacy training, including multi-lingual offerings, in person and online	Support equity priority populations (e.g., seniors, unhoused, low-income, etc.) in use of available digital equity tools and develop “Service Learning Credits” in partnership with our educational community and other training programs
Access to internet via equipment/hardware for seniors, low-income and unhoused population	Expand internet access availability and support with programs such as Service Learning Credits to bridge digital divide
Continued connection and partnership with the scientific community	Enhance City’s contribution to reaching environmental goals
Affordable broadband internet subsidized by the City	Enhance internet availability in the City by coordinating with private ISPs to expand available affordable options
Legislation to prevent predatory tactics used by ISPs to escalate prices	Protect equity priority populations from tactics that expand digital divide
Publicity/marketing plan to advertise City resources available to the public, including non-digital notifications (newspapers, mailers, etc.)	Enable access to City resources for all residents, visitors, and businesses

Table 12: Regional Partners Needs Summary

Need	Objective
Traffic signal coordination between jurisdictions (Caltrans, Oakland, San Leandro)	Enhance regional coordination and provide seamless traffic operations across jurisdictional borders, particularly at entry/exit points to the city and in case of an evacuation
Traffic signal coordination with transit queue jumps on key transit routes	Enhance transit reliability, which in turn encourages transit use; support roadway equity
Improved transit amenities, including real-time bus arrival/departure infrastructure, as City owns bus stop amenities	Encourage transit use; support roadway equity
Provide Transit Signal Priority (TSP) on key transit routes	Enhance transit reliability, which in turn encourages transit use; support roadway equity
Consider connection with Lit San Leandro, a public private partnership that provides broadband internet service focused on the business community in San Leandro	Enhance regional internet availability
Shared GIS fiber network map among regional partners	Boost regional coordination for better regional planning for enhancements to communications network architecture
Lane enforcement system for bus only lanes	Enhance transit reliability, which in turn encourages transit use; support roadway equity

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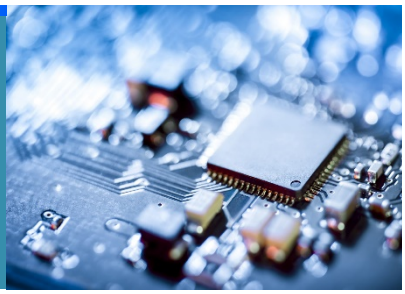
CHAPTER 5: Smart City Strategies & Recommendations

In this Chapter

- Discussion of common Smart City strategies.
- Discussion of recommendations to meet City of Alameda's needs.



Smart City is a fairly loosely defined term and thus can encompass a large number of initiatives. The National League of Cities (NLC) describes a smart city is one "that has developed some technological infrastructure that enables it to collect, aggregate, and analyze real-time data and has made a concerted effort to use that data to improve the lives of its residents." The US Department of Transportation (USDOT) has described a smart city is one that "uses advanced data and Intelligent Transportation Systems (ITS) technologies and applications to reduce congestion, keep travelers safe, protect the environment, respond to climate change, connect underserved communities, and support economic vitality." However, there is a general consensus that a smart city is comprised of the following main components:

- Devices and applications that collect data;
- A communications network to support the collection and dissemination of data;
- Applications and tools to analyze and interpret the data to provide actionable insight; and
- An organizational structure that utilizes this intelligence as predictive analytics to improve services for and engage with community members.

In essence, a smart city initiative is multi-layered, starting with a communications infrastructure, with connect networked devices, and the data from these devices used to improve daily operations and services to the public. Based on the needs and objectives expressed by the various project stakeholders, a number of recommendations have been developed to address these needs. Note that many of the needs expressed by various stakeholders overlap and thus a number of the recommendations address multiple needs.

It should also be noted that the implementation of Smart City initiatives may also require additional personnel support to fully utilize and benefit from the systems, as noted in the fourth bullet point above. The proposed Smart City infrastructure and systems are merely tools, and the value of these tools are only realized if there are adequate and trained personnel to use these tools. This may include expanded staffing for roles such as network analysts, field staff for Underground Service Alert (USA) support, or other operations and maintenance staff. As City systems and operations grow, so will the need to acquire additional support for day-to-day management, operation, and maintenance.

The following recommendations are intended to guide the City in the strategic investment and deployment of Smart City infrastructure and applications to achieve its Smart City goals and objectives by improving city services, mobility, safety, and the environment, thus enhancing the quality of life for its residents.

Recommendation #1 Details

Recommendation Overview

Deploy citywide communications network to interconnect City facilities and infrastructure and serve as a foundation for other Smart City initiatives.

Associated Smart City Goals

- Equitable Internet
- Government Transparency & Cyber Security
- Transportation Operations
- Safety
- Economic Vitality
- Climate Goals

Associated Stakeholders

- Public Works
- IT
- AMP
- Recreation & Parks
- Public Safety
- Economic Development
- Educational Institutions
- Equity Priority Populations
- Regional Partners (all)
- Community Science

Complementary City Plans

- Emergency Operations Plan
- Alameda General Plan
- Information Technology Strategic Plan
- Economic Development Strategic Plan
- Transportation Choices Plan
- Climate Action and Resiliency Plan

Priority Level

High

Investment Level

$30 Million

Recommendation #1: Build Out City Communications Network

The foundation of a Smart City is the communications network on which the Smart City elements are able to interconnect. According to the USDOT's recent Putting People First: Smart Cities and Communities, "Undergirding these technologies is an integrated information and communications system. Strong information technology architecture and standards are the backbone of Smart Cities & Communities – allowing smooth data connections; creating opportunities for partnerships and public engagement; and enabling innovative cross-cutting, data-driven solutions." Establishing a municipal broadband communications network will provide the foundation for which various Smart City initiatives and applications such as public safety, mobility, economic development can be built upon.

The recommended communications network would consist primarily of a fiber optic network that would interconnect the majority of the City's existing facilities and infrastructure and would serve as the communications infrastructure backbone. The fiber optic communications network would be supplemented using wireless communications as a "last-mile" solution to connect remote or lower priority infrastructure, enabling the City to reduce the amount of undergrounded infrastructure. Remote or lower priority infrastructure may include an isolated traffic signal or a non-critical city facility.

Figure 8 depicts the proposed network layout for the recommended communications network. The fiber optic network has been designed to interconnect all key city facilities (both City Halls, Emergency Operations Center, Police Department, Maintenance Service Center, and all fire stations) and most signalized intersections. The network is designed for resiliency and provides multiple redundant paths to interconnected facilities in the event of

a localized failure or accidental fiber cut. The network has also been designed to support other potential Smart City applications and devices such as a public Wi-Fi deployment and traffic monitoring cameras by functioning as a communications back-haul for these devices.

The proposed communications network would provide infrastructure to support the majority of the City's Smart City goals, as well as most of the involved stakeholders. The network will enable the City to reduce its dependency on AMP infrastructure, providing the City with infrastructure managed internally. It will enable many of the remote operational needs discussed previously, providing reliable City-owned infrastructure on which to build those systems (e.g., signals, facilities, lighting, irrigation, pump station management, parking, etc.). The network will also support the continued digitization of City services, again providing a dedicated network to be able to interconnect all City service facilities to provide cohesive services.

The network will support the City's need for more robust transportation-related data collection, providing a way to remotely access that information and improve system management, including across jurisdictions. It will also empower the City to support the future of transportation technologies like connected and autonomous vehicles. These systems require roadside equipment and communications to work effectively.

In addition to infrastructure, the build-out of the system also provides the opportunity for the development of additional soft skill resources. With support from robust communications, programs like the Alameda Adult School technology courses would be able to expand. The opportunity for other City-sponsored programs like Senior technology support and student community service credits would also expand when supported by the network. The introduction to the network will increase technological literacy throughout Alameda as a result.

Management and maintenance of this network will likely require additional City staff support for the long term. Though fiber optics and wireless communications are relatively low maintenance, software and hardware management is a key element to a well-functioning communication system. This task would likely fall jointly to IT and Public Works to ensure all communications links are operating satisfactorily both in the field and within facilities.

Investment in a large-scale communications network comes with a substantial cost. The cost of installation of hardwired fiber optic cables can be high and varies with the construction market; the cost of wireless solutions are less but come with a shortened equipment life expectancy. The network depicted as part of this recommendation will likely cost several millions of dollars and will likely need to be implemented in a phased manner. Phasing of communications implementation should balance the operational need for the communications link in the greater physical network with the available funding. In general, a core central communications ring should be built out first with phased expansions identified down the road. For that reason, the time frame of this recommendation ranges from short- to long-term depending on the priority and available funding for the improvements.

Why Fiber Optics?

Fiber optic communication has become the industry standard of the telecommunications industry because of fiber's massive throughput capabilities, low latency performance, and relative physical durability. Compared to its much slower predecessor, copper cable, fiber enables opportunities for more interconnection bandwidth that is able to serve even more devices, sensors, and systems (i.e., the "Internet of Things"). Incorporating fiber optics will position the City to be ready to support current and future needs.

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Figure 8: Recommended Communication Network Infrastructure

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Recommendation #2: Deploy Wi-Fi in Public Spaces

Internet access is considered an essential service and is recognized as a human right in some countries. Wireless connection to the internet has become almost ubiquitous in our society as more and more common everyday devices, such as kitchen appliances, are now "on-line." Wireless networks (Wi-Fi), and the resulting access to the internet, has become commonplace throughout our work environment and at home. Public agencies and organizations initially deployed Wi-Fi at their facilities to support municipal operations but have expanded the use to provide a public benefit such as digital inclusion, economic development, and services to an underserved population who do not have internet access at home. The recent pandemic has required students to transition to on-line schooling, workers to work from home, and has even meant that seeing a doctor was done on-line via telehealth/telemedicine.

As a first phase, it is recommended that the City deploy a public Wi-Fi service starting with city buildings and city-owned outdoor spaces. For city buildings, this would include both City Hall buildings, Police Department, Emergency Operations Center, Maintenance Service Center, and recreation centers. For outdoors spaces, this would include most city parks, the three ferry terminal lots, key corridors including Park Street and Webster Street and priority equity neighborhoods such as Alameda Point. For later implementation phases, City staff will conduct further input to ensure that the public Wi-Fi is deployed at high priority locations for community members beyond the locations mentioned above, such as at bus stops or other gathering places. Operations and maintenance of these networks will likely fall to IT and depending on the extent of deployment may require additional staffing to support the system. Deployment of this system will largely depend on the deployment of the supporting fiber optic communication network which would affect deployment timeframe.

Recommendation #2 Details

Recommendation Overview

Deploy Wi-Fi in public spaces to support the ever-growing need for broadband access in Alameda. Free internet access through public Wi-Fi facilities would enhance internet availability and decrease the digital divide for Alameda residents.

Associated Smart City Goals

- Equitable Internet
- Economic Vitality

Associated Stakeholders

- Public Works
- IT
- AMP
- Recreation & Parks
- Economic Development
- Educational Institutions
- Equity Priority Populations

Complementary City Plans

- Alameda General Plan
- Information Technology Strategic Plan
- Economic Development Strategic Plan

Investment Level

$4.5 Million

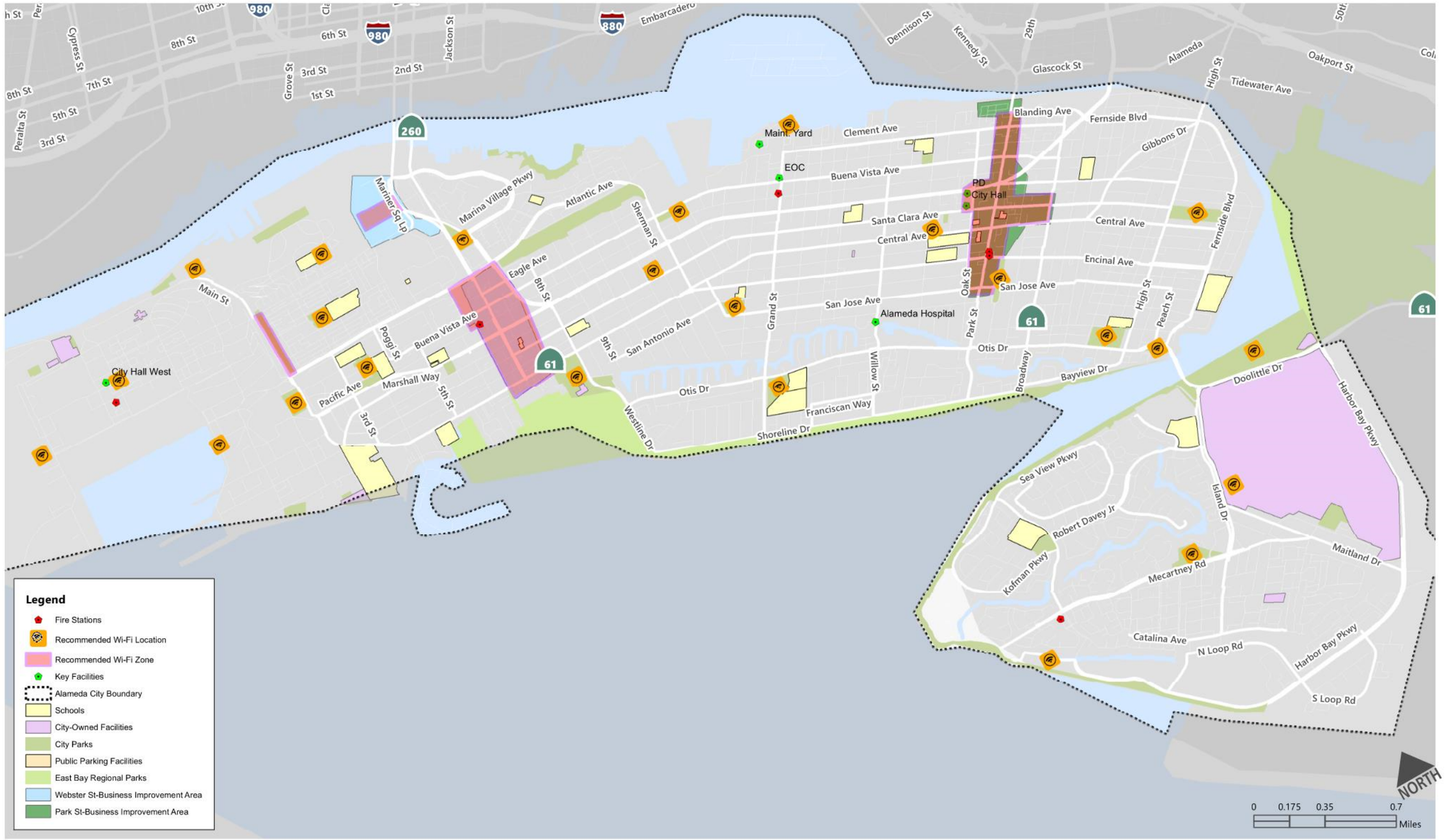
Priority Level

Medium

Proposed locations for public Wi-Fi services are depicted in **Figure 9**. These locations are mainly centered around public spaces, like public buildings, parks, streets, and commercial and business districts as mentioned previously. The Wi-Fi locations are supported by the recommended fiber optic communications network to serve as backhaul for this service. Backhaul will be especially necessary for sufficient bandwidth availability and internet connection. For outdoor and public spaces, it is recommended to utilize the traffic signal infrastructure as that provides a convenient location to access power, an established connection to the recommended fiber optic network for backhaul, and signal poles that provide height and secure mounting locations for wireless access points.

The capital investment associated with this technology is moderate and implementation will likely also follow a phased approach. It is recommended that City observe a prioritization of deployments such that they deploy services to the areas where it is most needed first. These priority areas may have implementation within a few short years (i.e., short term), while lower priority locations may take longer. Thus, the deployment of this recommendation is expected to be a short to long term timeline to balance the needs of the City and areas that will be served by the public wireless network.

Figure 9: Recommended Public Wi-Fi Access Locations



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Recommendation #3: Deploy Citywide Emergency Vehicle Preemption (EVP)

As part of the public safety goal, it is recommended that emergency vehicle preemption (EVP) be deployed at all signalized intersections in Alameda to improve emergency incident response time and safety at intersections during an emergency. This preemption will assist in reducing emergency response time by granting priority to emergency vehicles at traffic signals. The preemption system would detect an approaching emergency vehicle and provide a green light to flush out any queued vehicles along the approach and/or hold the light green until the emergency vehicle has made it past the intersection. Thus, emergency vehicles would no longer have to run a red light, making it safer for everyone while also increasing the response time. This recommendation would entail installation of fleet equipment in conjunction with intersection equipment. Prioritization of these deployments would ideally follow emergency responder's data regarding most used routes and along heavily congested corridors. Signalized intersections in more remote or isolated areas may be lower in priority in terms of deployment.

The implementation of this measure can be combined with Recommendation #4 to deploy transit signal priority (TSP) to reduce travel times while riding the bus in Alameda. The City currently has TSP deployed at signalized intersections along the AC Transit Line 51 route along Webster Street. The TSP system used along the Line 51 deployment is Global Traffic Technologies' (GTT) GPS-based system. It utilizes a combination of GPS-based tracking and wireless radio communications equipment installed at traffic signals to detect approaching transit vehicles and provides them with priority treatment such as triggering an early green light or holding an already green light to maximize the opportunity for the vehicle to pass the signal without having to stop and wait at a red

Recommendation #3 Details

Recommendation Overview

Deploy citywide Emergency Vehicle Preemption to support the improvement of emergency incident response and safety on roadways during these incidents.

Associated Smart City Goals

- Transportation Operations
- Safety

Associated Stakeholders

- Public Works
- Public Safety

Complementary City Plans

- Emergency Operations Plan
- Alameda General Plan
- Hazard Mitigation Plan

Investment Level

$3-3.5 Million (in conjunction with Recommendation #4)

Priority Level

High

light.

This same system is capable of doing double-duty and can support both TSP and EVP operations. Thus, the same equipment that would be installed at a signalized intersection can be utilized for EVP and TSP. For EVP functionality, the City's emergency vehicle fleet would have to be equipped with the corresponding GTT equipment, which is the same equipment that is installed in AC Transit buses for TSP.

Deployment of EVP and/or TSP can be a short-term implementation that would entail deployment along existing emergency routes. Deployment to all City intersections and City emergency fleet could be implemented within a short-term timeframe due to standardization of the system equipment. In addition, the capital investment is moderate.

Recommendation #4: Deploy Transit Signal Priority (TSP)

In coordination with AC Transit, deployment of transit signal priority (TSP) along key transit routes in Alameda would improve transit service. TSP offers priority to transit vehicles ensuring that transit routes operate on schedule. Providing this additional functionality will reduce travel times for bus operations around the City, which in turn would enhance transportation options for residents and others accessing Alameda, and ultimately contribute to transportation equity. This investment may also allow AC Transit to improve service frequency or consider new routes, further providing additional transportation options within and to Alameda, contributing to the city's various economic and climate goals. Installation of TSP would also require close coordination with AC Transit, as they have specific system requirements as noted in Recommendation #3.

Proposed locations for TSP deployment are depicted in **Figure 10** which follows most of the current AC Transit routes that serve the City. Also similar to Recommendation #3, deployment of TSP at any signalized intersection also means that EVP functionality will also be provided at that location.

Similar to EVP, implementation of TSP may be achieved within a short-term timeframe. Capital costs can be combined with the EVP deployment and implementation may be done faster than EVP since TSP would only need to be deployed along key AC Transit routes in Alameda. Additionally, there is opportunity in coordination with AC Transit for cost sharing, so the financial investment for this improvement may be lessened for the City.

Recommendation #4 Details

Recommendation Overview

Deploy TSP along key transit corridors to support improvements to AC Transit service, as well as enhance multi-modal options for the City's residents. TSP improves transit reliability, allowing AC Transit to better serve Alameda riders.

Associated Smart City Goals

- Transportation Operations
- Economic Vitality
- Climate Goals

Associated Stakeholders

- Public Works
- Economic Development
- Equity Priority Populations
- Regional Partners (AC Transit)

Complementary City Plans

- Climate Action and Resiliency Plan
- Economic Development Strategic Plan
- Transportation Choices Plan

Investment Level

$3-3.5 Million (in conjunction with Recommendation #3)

Priority Level

Medium

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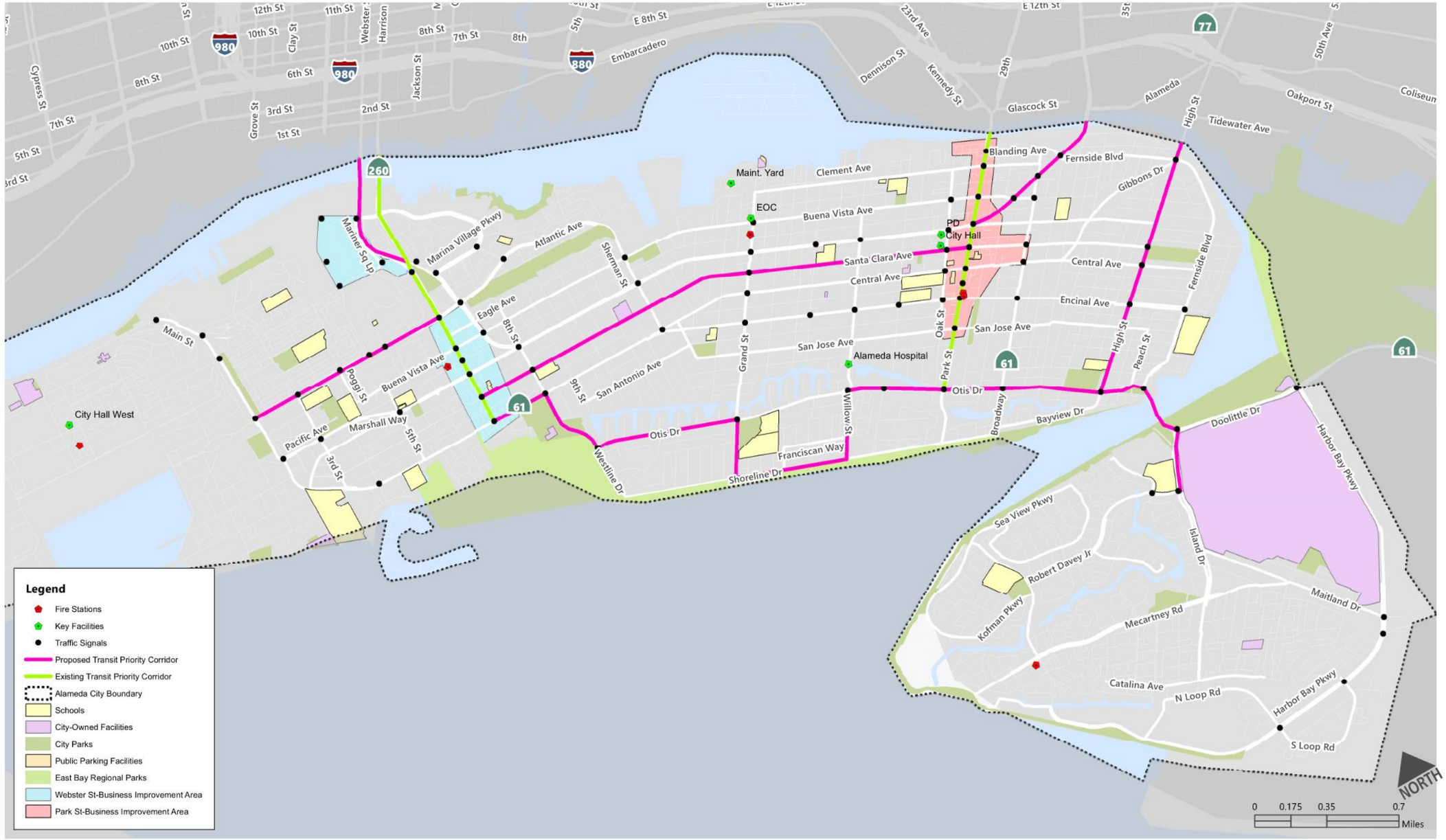
Figure 10: Recommended Transit Priority Corridors



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Recommendation #5: Partner with Internet Service Providers

As a means to improve internet availability and options, the City should partner and coordinate with internet service providers (ISPs). Partnerships with ISPs could include collocation on City infrastructure for 5G equipment, which would expand cellular service in Alameda. It could include joint trench opportunities for conduit and/or fiber installations building out Recommendation #1. It could also include development of City incentives to attract more ISPs to Alameda to provide more options for home and business internet service in Alameda. The City may also consider development of policies in conjunction with these efforts that would work to prevent or reduce predatory practices regarding internet pricing in Alameda. These partnerships and conversations with ISPs are timely as most ISPs are also offering Smart City programs and could be a short-term action to improve internet equity with relatively low-cost impact.

Recommendation #5 Details

Recommendation Overview

The City should establish partnerships with ISPs serving Alameda resides to improve service availability, terms, and speeds. By providing development incentives, the City may also attract additional ISPs to the island.

Associated Smart City Goals

- Equitable Internet
- Economic Vitality
- Climate Goals

Associated Stakeholders

- IT
- Economic Development
- Educational Institutions
- Equity Priority Populations

Complementary City Plans

- Alameda General Plan
- Economic Development Strategic Plan
- Climate Action and Resiliency Plan

Investment Level

Less than $100,000

Priority Level

Medium

Recommendation #6 Details

Recommendation Overview

Develop and implement a Dig Once policy that will protect the City's investment in its infrastructure by ensuring that all development work is completed at one time in specific areas. Additionally, the City should develop installation standards which will ensure that infrastructure around the City is built consistently.

Associated Smart City Goals

- Transportation Operations
- Safety
- Equitable Internet
- Economic Vitality
- Climate Goals
- Government Transparency & Cyber Security

Associated Stakeholders

- Public Works
- Transportation Planning
- IT
- AMP

Complementary City Plans

- Alameda General Plan
- Zero Waste Implementation Plan
- Climate Action and Resiliency Plan

Investment Level

Less than $100,000

Priority Level

High

Recommendation #6: Develop Dig Once & Installation Standards Policies

A Dig Once policy would establish a guideline that would not only protect existing infrastructure but would also proactively build out the City's upcoming infrastructure needs. The Dig Once policy would also provide a mechanism by which developments would be required to contribute to public right-of-way improvements in Alameda, including those which are discussed in this plan. This policy would also likely improve coordination with the various non-City utility companies and provide more joint trenching opportunities which will in turn minimize impact on existing facilities.

In addition to Dig Once policies, the City should also develop installation standards policies which will dictate standards for all City infrastructure installations. Examples of this would include standardization of signal equipment, new or modified roadway standards, or public street frontage requirements. These types of policies ensure that new installations are easily operated and maintained and are consistent with existing infrastructure and assets. Preparation of these types of policies could be completed in a relatively short-term timeframe.

To support these policies and standards, the City may find that additional personnel resources may be required. It's expected that checks and balances on the Dig Once policy may be required to ensure that all planned infrastructure is accounted for with each Dig Once inquiry. Further, maintenance of City standards will also be required, as industry standards and City equipment and hardware preferences may evolve over time. This person would also act as the single point of contact for implementing the Dig Once policy and the City's standards. Policy development is likely a lower cost effort and may be implemented by existing City staff, and thus has been assigned a short-term timeframe.

Recommendation #7: Implement Centralized Transportation Management

To better manage traffic and the traffic signal system around the City, establishment of centralized traffic management functionality would be ideal. This would offer a central location for real-time traffic incident monitoring, including during emergencies, and remote-control capabilities of all interconnected traffic signals. This would also enable a central location for CCTV monitoring of key traffic corridors, allowing for improved coordination with public safety and improved maintenance response times as well. While some of these needs are not currently urgent, the deployment of this kind of functionality would require communication capabilities with all of the managed equipment to first be established.

Centralized transportation management has traditionally meant a physical room or dedicated space where traffic management operations, management and monitoring has taken place. This was the case when most communications and underlying technologies were analog and typically could only be routed to one central location. With greater bandwidth capabilities and the switch to digital and networked communications (Ethernet), centralized transportation management today can be anywhere from the traditional dedicated physical room to a workstation on someone's desk, or a laptop in the field. As long as the physical infrastructure and software applications are in place to support it, centralized transportation management can be established in any or multiple locations.

For day-to-day operation, it is recommended that centralized transportation management be established at the Maintenance Service Center for use by traffic signal maintenance staff to monitor, detect, and assist in the troubleshooting of any maintenance or operational issues related to the traffic signal

Recommendation #7 Details

Recommendation Overview

Implement a centralized transportation management system to assist City Staff in the operations and maintenance of its transportation network and infrastructure. This type of system would specifically allow for management and monitoring of the City's network of signals, intersections, and roadways and would aid improving incident response and increase maintenance efficiency.

Associated Smart City Goals

- Transportation Operations
- Safety

Associated Stakeholders

- Public Works
- Regional Partners (AC Transit)
- Transportation Planning
- Public Safety

Complementary City Plans

- Alameda General Plan
- Transportation Choices Plan

Investment Level

$1.5 Million

Priority Level

Medium to Low

infrastructure. This functionality should also be established at City Hall West for Public Works engineering staff to monitor, manage, and operate the traffic signal infrastructure. In the case of emergency operations where the EOC is activated, this functionality should also be established in the EOC to coordinate transportation related activities to support emergency response activities. Ultimately, these three facilities should be interconnected to provide the ability for seamless system management at any of the three locations.

As part of establishing centralized transportation management functionality, it would also be necessary to update the system that will manage the signal equipment. The City currently has a basic Econolite Centracs advanced traffic management system (ATMS) license but should consider expanding the use of this tool. The use of an ATMS like Centracs would enable City staff and the City traffic engineer to manage and monitor traffic operations in real-time and remotely. ATMS systems provide a centralized dashboard to view and manage signal system performance and are a key tool in incident and emergency response. ATMS systems will also provide a reduction in maintenance monitoring staff time with automated tools that notify when equipment may need attention, allowing the City to have a proactive maintenance response. Acquiring the ATMS tool is likely not a high priority until most of the communications network is built out, so a mid-term timeframe would be expected.

Management of an ATMS system can be performed by existing City personnel. It's envisioned that the City's transportation staff, such as a traffic engineer, would take on this role, ultimately performing most system planning, upgrades, and maintenance of the ATMS system. Since implementing centralized transportation management requires other improvements, such as communications, to be implemented first, a mid-term timeline is appropriate. The capital investment is moderate for associated system licensing, software, hardware, and support services.

Recommendation #8: Interconnect Emergency Operations Center & City Facilities

An important element of a Smart City is a central location where City staff may manage systems and emergency response. The City has recently established an Emergency Operations Center (EOC), which will serve as that central location for managing City services. As discussed in previous recommendations, in order to effectively provide that service, the EOC should be interconnected to the rest of the City's many facilities and service centers. This would be supported by Recommendation #1, which would ultimately reduce City dependency on AMP communications infrastructure. The interconnection of the EOC would also provide a secondary management location for Public Works assets.

This interconnection of the EOC would support the needs of various City departments, including Public Works, Public Safety, and IT. Implementation of this recommendation would likely occur once sufficient supporting infrastructure from Recommendation #1 is in place and would likely involve last-mile connections to the EOC building itself.

Interconnection of the rest of the City's various facilities to the EOC would provide the ability to enhance IT support and maintenance across the City's various offices and services, allowing for a more unified system. This approach would empower the City to manage its own network needs, including as it relates to cybersecurity. Being that the City has a multitude of facilities spread throughout the City, this would be a longer-term recommendation and would require prioritization of facilities to connect. The main work under this recommendation would be last mile installations to the facilities, which may increase cost being that they are to existing facilities and would require building modification.

Recommendation #8 Details

Recommendation Overview

Interconnect various City facilities and the Emergency Operations Center to enable City IT to establish an autonomous municipal network. This would empower City IT to manage the City's infrastructure, as well as mitigate cyber threats and improve government services.

Associated Smart City Goals

- Government Transparency & Cyber Security
- Safety

Associated Stakeholders

- Public Works
- IT
- AMP
- Recreation & Parks
- Public Safety
- Educational Institutions

Complementary City Plans

- Emergency Operations Plan
- Alameda General Plan
- Information Technology Strategic Plan
- Hazard Mitigation Plan

Investment Level

$10-12 Million (in conjunction with Recommendation #1)

Priority Level

High

Recommendation #9 Details

Recommendation Overview

Transportation data analytics is quickly becoming the cutting edge of transportation planning and operations. The City can outfit their transportation network with hardware providing improved data collection capabilities that, coupled with powerful software tools, can provide useful insights on hotspots, multi-modal trends, and help to identify where investment opportunities may exist. In addition, the City may utilize many of the Software-as-a-Service (SaaS) platforms that heavily reduces the upfront capital investments in exchange for on-going service fees.

Associated Smart City Goals

- Transportation Operations
- Safety
- Climate Goals

Associated Stakeholders

- Public Works
- Transportation Planning
- Public Safety

Complementary City Plans

- Climate Action and Resiliency Plan
- Alameda General Plan
- Transportation Choices Plan

Investment Level

$4.5 Million

Priority Level

Medium

Recommendation #9: Implement Transportation Data Analytics

As traffic signal safety standards continue to evolve, it is important that signal systems are as close to current standards as possible. The City has a mixture of older equipment and new equipment. To achieve some of the other Smart City goals like automation, signal performance monitoring, or adaptive signal timing, signal equipment will need to be updated to best practice standards, which includes upgrades to the signal controllers, traffic detection technologies, and other auxiliary signal cabinet equipment. These upgrades will enable the City to begin collecting high-resolution multi-modal data, which will inform where transportation network deficiencies exist, which key corridors or areas are most utilized, and thus can help inform where transportation investments should be targeted. This technology is also potentially capable of collecting speed data, pedestrian volumes, bicycle volumes, and transit data, which would also be extremely useful to City planning efforts such as transit-oriented development, complete streets, and other multi-modal solutions.

Upgrade of equipment will also bring the technology up to best practice standards to be able to utilize the planned communications infrastructure (e.g., Ethernet). The City has already begun this process with the current use of Econolite's Cobalt traffic signal controllers and AutoScope video detection systems. These devices, in addition to serving its main function of operating a traffic signal and detecting vehicles, are able to collect data that can be analyzed to provide insight into roadway performance and utilization. The Cobalt controller is capable of logging signalized intersection activity in high resolution which when combined with an automated traffic signal performance monitoring system (ATSPM) can be used to understand and improve signal operations. The video detection system is capable of collecting intersection traffic counts

that can provide insight into overall utilization, when the intersection is most used, how long that occurs, and which specific movement(s) are the most utilized and when. At the moment, this capability is not being utilized as there is not the existing communications infrastructure in place to retrieve the data from these devices in the field and there is no central repository and application platform to store and analyze this data.

Overall, having up to date equipment will aid in improving intersection safety and will contribute to enhancing transportation operations citywide for all modes, allowing the City to manage and reduce delay and emissions while also making it easier to walk, bicycle and take the bus.

Implementation of this recommendation is tied to investments for equipment at City intersections and other supporting infrastructure. For this reason, the timeline for implementation will be longer term as it likely will depend on supporting infrastructure to be implemented first. Installation of all of these improvements would also need to be phased and may be subject to available funding for this type of work. This would likely push the time frames out to be more mid- to long-term.

In addition to data that would be generated by the City's own infrastructure, the City can also consider the use of third-party data sources, such as INRIX, Here, Streetlight, and Wejo, to serve its data needs for decision making. For example, the City has access to INRIX data through the Metropolitan Transportation Commission. One of the limitations to using these third-party data sources is that the data is based on a sampling of a sub-set of the overall data population as a way to represent the entire data population. So the use of third-party data is very good for determining measures such as travel speed, travel time, and origin-destination since a sub-set data pool can be fairly accurate in representing the behavior of the entire data population, but not very accurate in representing total demand or usage such as traffic volumes. Data from these sources are usually available via a subscription model and may aid the City in implementing the use of detailed data in the nearer term.

It should also be noted that the City has already embarked on several other science-related data collection efforts in partnership with the California for Education Network Initiatives in California (CENIC) via the Berkeley Labs. The CENIC data collection deployment for monitoring seals offshore at Alameda Point is serving as a pilot project for the City to partner with the science community and meet some of its environmental goals.

Recommendation #10 Details

Recommendation Overview

Deployment of a CCTV camera network at key locations within the City's main travel districts, including the business districts, and at island access points will enable the City to improve incident response and monitor system performance at these key areas.

Associated Smart City Goals

- Transportation Operations
- Safety

Associated Stakeholders

- Public Works
- Transportation Planning
- Public Safety

Complementary City Plans

- Emergency Operations Plan
- Alameda General Plan
- Transportation Choices Plan

Investment Level

$1 Million

Priority Level

Low

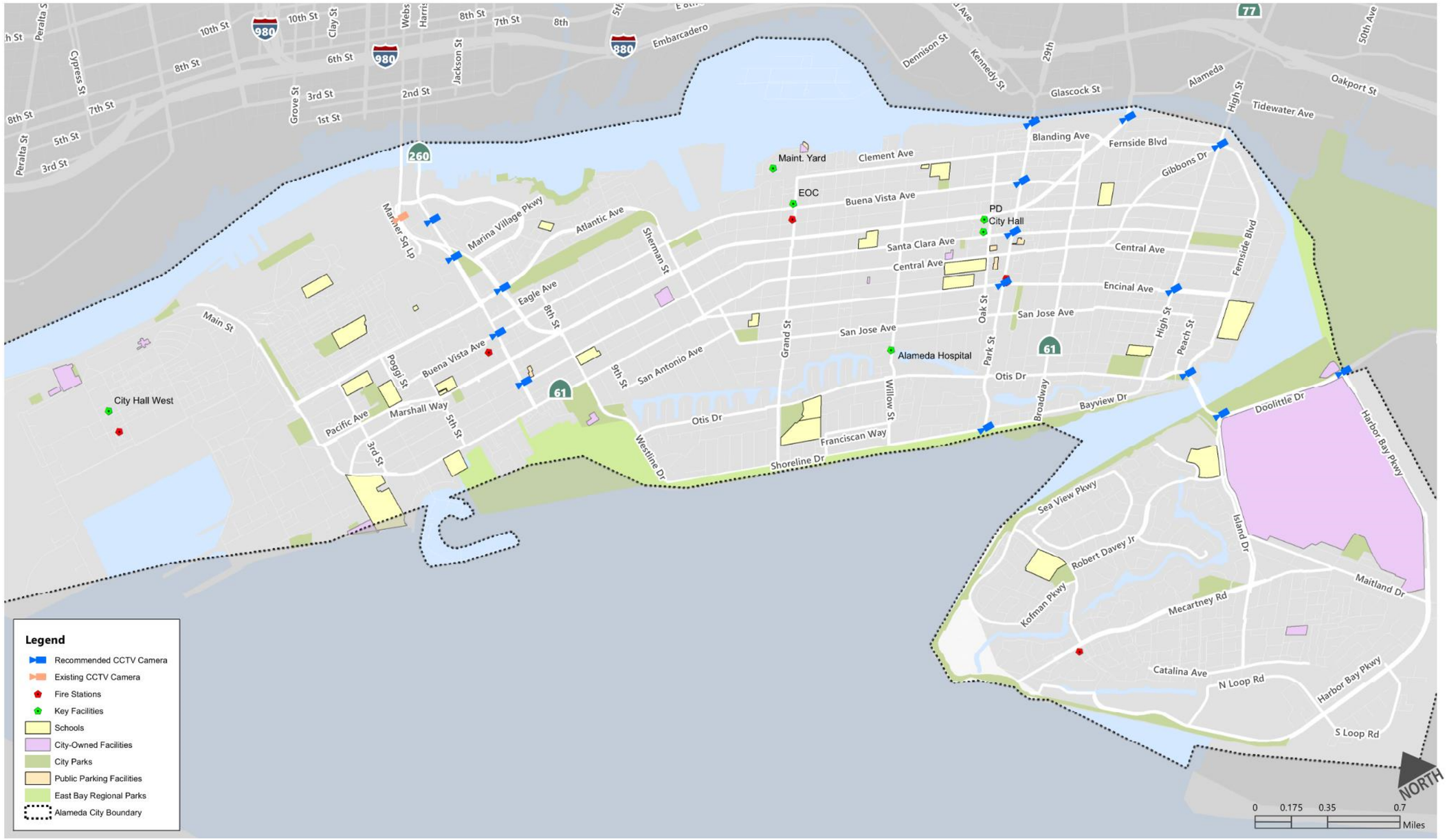
Recommendation #10: Deploy Traffic Monitoring Camera Network

To enhance traffic and incident management in Alameda, a network of CCTV cameras is recommended. CCTV cameras would be strategically placed on city streets around the City to monitor areas that are key to circulation or areas that frequently experience issues requiring mitigation. This capability would enable City staff to monitor these areas remotely, thus improving incident detection and emergency response. It could also be especially useful at gateway traffic bottlenecks, like the tubes and bridges on and off the island. The use of these CCTV cameras would be for live viewing only, and images would not be recorded or used for surveillance or tracking. The CCTV cameras would essentially function as a substitute for a staff person standing on the street and making observations. It should be clearly noted that the intent of this system is not for security or policing and would only function as non-recording observational tools for transportation network monitoring.

Proposed locations for CCTV deployment are depicted in **Figure 11**. Given the importance of privacy and privacy concerns, the recommendation for CCTV camera deployments have been limited to key commercial corridors such as Webster Street and Park Street and the five access points to/from the City. Care was taken not to locate any CCTV cameras in areas that are primarily residential.

Since traffic monitoring is a lower priority within the City but would offer numerous benefits, this recommendation has been assigned a long-term timeframe. Further, CCTV cameras and the associated management systems would require the communications network infrastructure to first be in place. It's recommended that this system be established following the deployment of the communications network in locations where CCTV cameras are planned, thus ensuring that the maximum benefit of the system will be able to be realized following deployment.

Figure 11: Recommended Closed Circuit Television System



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CHAPTER 6: Smart City Projects & Prioritization

In this Chapter

- Identify Foundational Smart City Projects
- Identify Smart City Expansion Projects
- Define proposed Smart City projects for Alameda

In order to execute the recommendations set forth within this plan, a phased approached is anticipated and is envisioned in two categories of projects:

- Foundational Smart City Projects
- Smart City Expansion Projects

Foundational Smart City Projects

As discussed in Chapter 5, Recommendation #1 encompasses the foundational base which most of the Smart City strategies will be built upon. A Smart City is supported by a robust and resilient communications network which provides interconnection of all systems in use. Thus, the establishment of this network is considered first priority as part of this effort. In order to build out the communications network, the proposed network has been subdivided into several sub projects which will also be prioritized based on the more immediate need and additional planned projects which will require the network be in place (e.g., deployment of Public Wi-Fi access). **Figure 12** shows the anticipated project segments for implementation. The following graphics detail the project specifics and anticipated planning-level costs for each, as well as expected priority of each based on the overall need in the area, and other project dependencies on the network in the area. It also includes estimated project timelines form initiation to completion.

Smart City Expansion Projects

Once a foundational communications project in a specific area is completed, expansion project(s) in that area may now be implemented and utilize the built communications network. These projects include the deployment of the other strategies such traffic signal interconnection, CCTV camera deployment, and Public Wi-Fi implementation. These projects are also summarized in the following tables, along with project specifics and anticipated planning-level costs for each. The graphics also include the expected priority of each based on the overall need in the area, any prerequisite projects required, and estimated project timelines from initiation to completion. **Table 13** presents a list of the proposed Smart City projects, as well as designates if the project is considered foundational, and indicates dependencies on other projects that must first be in place. **Figure 13** summarizes the anticipated project areas for the Wi-Fi related projects.

Project Cost Development

An important element of the proposed projects within this Plan is the anticipated implementation cost of the projects. Cost development for these projects is based on unit prices obtained from FHWA and Iteris' recent project experience and then tailored for the Northern California market with a 35% continency added. Cost details for each project are included in **Appendix B**.

Table 13: Smart City Projects

Project ID	Project Name	Foundational	Dependencies
C1	Central City & EOC Communications Project	✓	None
C2	City Hall West Interconnection Project	✓	C1
C3	Encinal Avenue Interconnect Project	✓	C1
C4	South Island Access Communications Project	✓	C1
C5	North Island Communications Project	✓	C1
C6	South Shore Communications Project	✓	C1
C7	Bay Farm Communications Project	✓	C1, C6
W1	Central Public Wi-Fi		C1, C3, C5
W2	Northern Public Wi-Fi		C1, C2, C5
W3	Southern Public Wi-Fi		C1, C3, C4, C6
W4	Bay Farm Public Wi-Fi		C1, C3, C6, C7
T1	Citywide EVP/TSP Deployment		None
T2	Centralized Transportation Management		C1-C7
T3	Implement Transportation Analytics		C1-C7, T2
T4	Citywide CCTV Deployment		C1-C7
S1	Partner with ISPs		None
S2	Develop Dig Once & Installation Standard Policies	✓	None

Prioritization

Prioritization of the projects is generally based on the urgency of the need as discussed in the various focus groups and the Recommendations portion of this Plan.

Project Definitions

The following tables provide a summary to each of the proposed projects, including a brief description of the anticipated scope of the project, cost, priority, estimated timeline, estimated duration, and identification of project prerequisites (i.e., which other projects need to be completed before this project may begin). The C and W projects are accompanied by **Figures 12** and **13** which graphically layout the planned projects discussed in the project definitions. Projects S1 and S2, which are associated with recommendations 5 and 6 respectively, are not included in the Project definitions because they are non-capital projects and primarily require staff time investment.

Note: the house icon indicates the project is foundational.

C1 Central City & EOC Communications Project

Project Details	Recommendation	Est. Project Cost
Construct underground fiber optic communications along Pacific Avenue and Grand Street which interconnects both business districts, and key City facilities: EOC, Maintenance Service Center, Alameda Police Department, and City Hall. This project involves deployment of 5.6 miles of fiber optic cable to serve as communications trunk and also interconnects to key city facilities with last mile connections which are on this corridor.	1, 8	$5.1M
	Priority	**Project Timeline**
	Highest	Short Term
	Prerequisite Project(s)	**Project Duration**
	none	2 Years

C2 City Hall West Interconnection Project

Project Details	Recommendation	Est. Project Cost
Construct underground fiber optic communications between the Central City project and City Hall West. The project also includes establishing a redundant ring connection along Central Avenue and serving all signals in the vicinity of this area. This project involves deployment of 7 miles of fiber optic cable to serve as communications trunk at the island bridge access points.	1, 8	$5.7M
	Priority	**Project Timeline**
	Highest	Short to Mid Term
	Prerequisite Project(s)	**Project Duration**
	C1	2 Years

C3 Encinal Avenue Interconnect Project

Project Details	Recommendation	Est. Project Cost
Construct underground fiber optic communications along Encinal Avenue, establishing a redundant connection between project C1 and project C2. This project also interconnects two fire department buildings to the citywide network and services signals along the corridor. This project will require coordination with Caltrans on State Routes. This project involves deployment of 4.3 miles of fiber optic cable to serve as communication trunk at the island access point and Webster business district.	1, 8	$3.9M
	Priority	**Project Timeline**
	Highest	Mid Term
	Prerequisite Project(s)	**Project Duration**
	C1	2 Years

C4 South Island Access Communications Project

Project Details

Construct underground fiber optic communications at the southeastern most access to the Island to provide communications along High Street, Tilden Avenue, and Fruitvale Avenue. This project will enable the deployment of various other technologies which can address incident issues at these access points which typically are identified as choke points for island access. This project interconnects with projects C1 and C3 and involves the deployment of 4.25 miles of fiber optic cable.

Recommendation	Est. Project Cost
1	$3.9M
Priority	**Project Timeline**
High	Mid to Long Term
Prerequisite Project(s)	**Project Timeline**
C1	2 Years

C5 North Island Communications Project

Project Details

Construct underground fiber optic communications in the Alameda landing development area, as well as easterly toward ferry facilities and Almeda point, also interconnecting with City Hall West via project C2. This project will also interconnect several remote signals potentially using relocated wireless communications equipment (from the Webster business district) on Marina Village Parkway, Atlantic Avenue, and Pacific Avenue. This project will require coordination with Caltrans on State Routes. This project involves deployment of 4.8 miles of fiber optic cable to serve as communication trunk at the island access point.

Recommendation	Est. Project Cost
1	$3.2M
Priority	**Project Timeline**
High	Mid to Long Term
Prerequisite Project(s)	**Project Timeline**
C1	2 Years

C6 South Shore Communications Project

Project Details

This project will interconnect the western portion of the island to the Park Street business district and the communications network ring. This project will interconnect several remote intersections and will provide connection to Alameda Hospital, a key facility on the island. This project involves deployment of approximately 3.6 miles of fiber optic cable to serve as communication trunk.

Recommendation	Est. Project Cost
1	$3.2M
Priority	**Project Timeline**
High	Mid to Long Term
Prerequisite Project(s)	**Project Timeline**
C1	2 Years

C7 Bay Farm Communications Project

Project Details

This project will interconnect Bay Farm Island to the main island fiber optic network ring. This project serves to also interconnect the Bay Farm fire station and is also a key regional connection element. This project involves deployment of approximately 6 miles of fiber optic cable to serve as communication trunk.

Recommendation	Est. Project Cost
1	$5.2M
Priority	**Project Timeline**
High	Long Term
Prerequisite Project(s)	**Project Timeline**
C1, C6	3 Years

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Figure 12: Proposed Communications Network Projects (Foundational Projects)

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W1 Central Public Wi-Fi Project

Project Details	Recommendation	Est. Project Cost
This project will deploy public wi-fi points within the central vicinity of the main island. This project entails the installation of wireless access points at key city facilities (buildings, parks, libraries, etc.). This work will also require interconnection to the fiber optic network to provide the internet access via the City's robust internet services.	2	$2.2M
	Priority	**Project Timeline**
	Medium	Short to Mid Term
	Prerequisite Project(s)	**Project Timeline**
	C1, C3, C5	2 Years

W2 Northern Public Wi-Fi Project

Project Details	Recommendation	Est. Project Cost
This project will deploy public wi-fi points within the northern vicinity of the main island. This project entails the installation of wireless access points at key city facilities (buildings, parks, libraries, etc.). This work will also require interconnection to the fiber optic network to provide the internet access via the City's robust internet services.	2	$1.1M
	Priority	**Project Timeline**
	Medium	Mid Term
	Prerequisite Project(s)	**Project Timeline**
	C1, C2, C5	2 Years

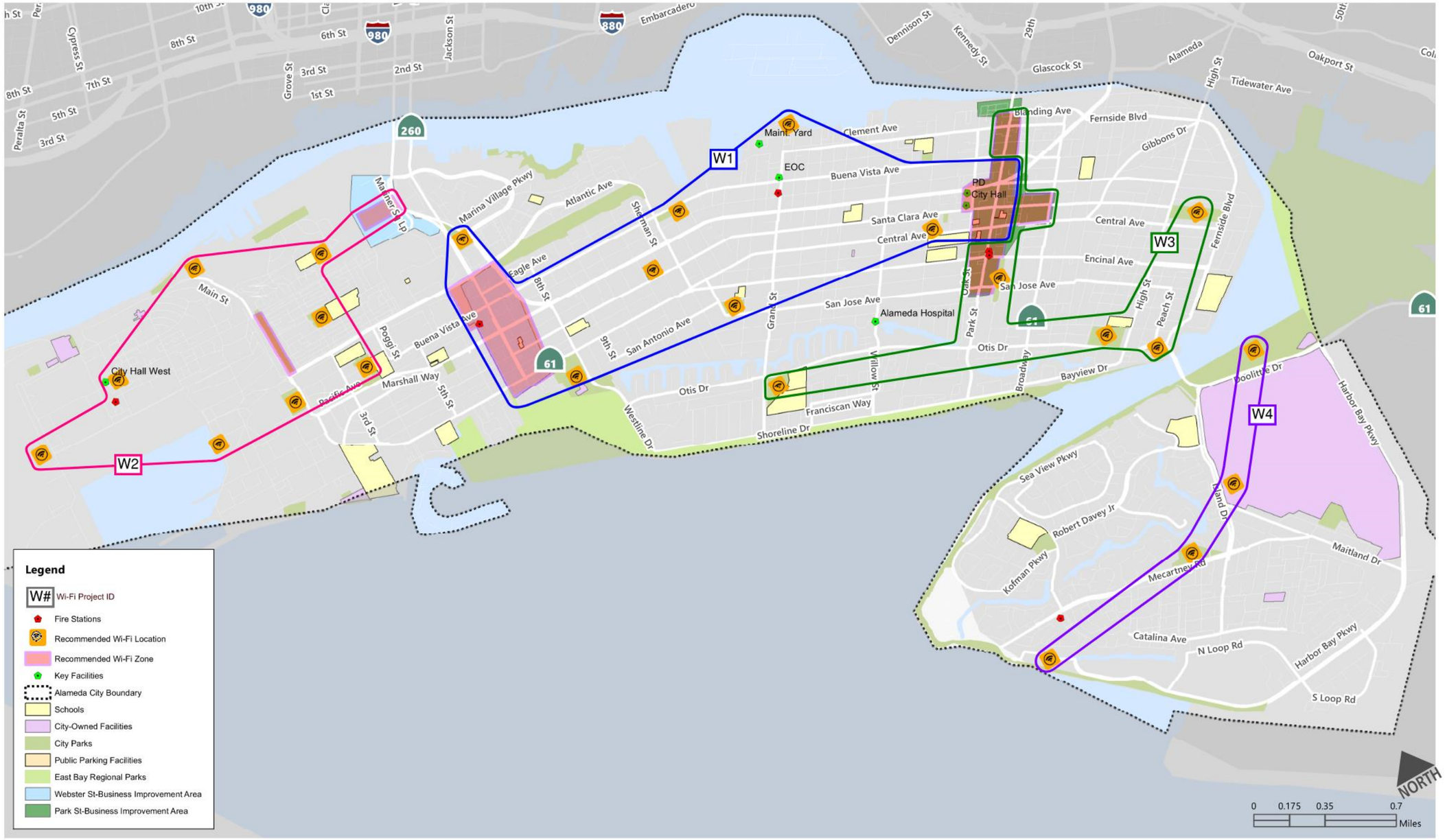
W3 Southern Public Wi-Fi Project

Project Details	Recommendation	Est. Project Cost
This project will deploy public wi-fi points within the south vicinity of the main island. This project entails the installation of wireless access points at key city facilities (buildings, parks, libraries, etc.). This work will also require interconnection to the fiber optic network to provide the internet access via the City's robust internet services.	2	$815,000
	Priority	**Project Timeline**
	Medium	Mid to Long Term
	Prerequisite Project(s)	**Project Timeline**
	C1, C3, C4, C6	2 Years

W4 Project Name

Project Details	Recommendation	Est. Project Cost
This project will deploy public wi-fi points within Bay Farm island. This project entails the installation of wireless access points at key city facilities (buildings, parks, libraries, etc.). This work will also require interconnection to the fiber optic network to provide the internet access via the City's robust internet services.	2	$350,000
	Priority	**Project Timeline**
	Medium	Long Term
	Prerequisite Project(s)	**Project Timeline**
	C1, C3, C6, C7	1.5 Years

Figure 13: Proposed Wi-Fi Projects



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T1 Citywide EVP/TSP Deployment

Project Details	Recommendation	Est. Project Cost
This investment effort involves the installation of EVP and/or TSP at all City intersections. This would also include the deployment of EVP equipment on the City's 21 emergency vehicles and potential coordination with AC Transit for possible cost-sharing arrangement on subprojects. This investment would likely be executed with a series of subprojects targeting certain groups or corridors of signals.	3, 4	$3.3M
	Priority	**Project Timeline**
	Medium	Short to Long Term
	Prerequisite Project(s)	**Project Timeline**
	none	4-5 Years

T2 Centralized Transportation Management System

Project Details	Recommendation	Est. Project Cost
This investment would deploy a centralized transportation management system which will utilize the city's vast communications network to operate and maintain its transportation system elements (signals, digital signage, or potential future smart devices). This project would involve the procurement of a central ATMS system and would also require outfitting intersections with current state-of-the-art controllers to enable effective remote management with state-of-the-art systems.	7	$1.5M
	Priority	**Project Timeline**
	Medium to Low	Long Term
	Prerequisite Project(s)	**Project Timeline**
	C1-C7	5-15 Years

T3 Transportation Analytics Implementation

Project Details	Recommendation	Est. Project Cost
This investment would involve the deployment of a Signal Performance Measures solution which utilizes high resolution data from the City's traffic signal controllers to provide insights about the transportation network. This project investment includes the deployment of VDS or additional advanced detection at all intersections which the City would desire to monitor for performance measures. This investment would likely be executed with a series of subprojects targeting certain groups or corridors of signals.	9	$4.5M
	Priority	**Project Timeline**
	Medium	Long Term
	Prerequisite Project(s)	**Project Timeline**
	C1-C7, T2	5-15 Years

T4 Citywide CCTV Deployment

Project Details	Recommendation	Est. Project Cost
This project would entail deployment of a closed-circuit television system via about 16 cameras at key island access points and busy transportation and business districts. The placement of cameras will be such that incident monitoring and response may occur. The system would be supported by the procurement of a basic video management system which allows remote monitoring of all cameras on the network.	10	$900,000
	Priority	**Project Timeline**
	Low	Long Term
	Prerequisite Project(s)	**Project Timeline**
	C1-C7	5-15 Years

CHAPTER 7: Funding Opportunities

In this Chapter

- A discussion of Federal, State, and Local funding opportunities for Smart City projects
- Identification of local funds already allocated for City of Alameda use

The projects and recommendations contained in this Plan are consistent with a multitude of large funding programs at the Federal level, within the State, and locally in the County of Alameda. The following sections describe potential funding sources which may help the City to realize the goals within this Plan.

Federal Funding Opportunities

Many federal programs distribute money directly to the State, which then distributes the funds based on local policies or award programs. A description of potentially applicable programs are described in the following sections.

CONGESTION MITIGATION AND AIR QUALITY PROGRAM (CMAQ)

This program was established by the 1991 Federal Intermodal Surface Transportation Efficiency Act (ISTEA) and was re-authorized in 2015 with the passage of the Fixing America's Surface Transportation (FAST) Act. CMAQ funds are directed to transportation projects and programs that contribute to the attainment or maintenance of National Ambient Air Quality Standards in nonattainment or air quality maintenance areas for ozone, carbon monoxide, or particulate matter under provisions in the Federal Clean Air Act. Eligible projects are as follows: public transit improvements; High Occupancy Vehicle (HOV) lanes; Intelligent Transportation Infrastructure (ITI); traffic management and traveler information systems (e.g., electric toll collection systems); employer-based transportation management plans and incentives; traffic flow improvement programs (signal coordination); fringe parking facilities serving multiple occupancy vehicles; shared ride services; bicycle and pedestrian facilities; flexible work-hour programs; outreach activities establishing Transportation Management Associations; fare/fee subsidy programs; engine diesel retrofits; alternative fuel vehicles; vehicle congestion pricing; freight intermodal projects; idle reduction projects; and under certain conditions, PM-10 projects. Routine rehabilitation projects and projects that are capacity increasing or highway expansion typically are not eligible. Operations projects may be funded for only three years.

REBUILDING AMERICA INFRASTRUCTURE WITH SUSTAINABILITY AND EQUITY (RAISE) GRANTS

The RAISE discretionary grant program was initiated by the U.S. Secretary of Transportation in November 2021. The RAISE program has replaced the Better Utilizing Investments to Leverage Development (BUILD) and Transportation Investment Generating Economic Recovery (TIGER) grant programs. Grants are awarded on a competitive basis for projects with significant regional or local impacts. These grants are designed to benefit surface transportation systems while providing further support to rural communities. The program selection criteria includes consideration for safety, environmental sustainability, quality of life, economic

competitiveness, state of good repair, innovation, and partnerships with a broad range of stakeholders. Within these criteria, the grants reflect the program's priorities for creating good-paying jobs, improving safety, applying transformative technology, and explicitly addressing climate change and advancing racial equity. The grants in 2021 amounted to $1 Billion of awards for 90 planning and capital projects in 47 states and were split 50-50 between rural and urban areas. During the 2021 cycle, the maximum project award was $25 million, and a single state could not receive more than $100 million. It is expected that this grant opportunity will be available again in 2022.

ADVANCED TRANSPORTATION AND CONGESTION MANAGEMENT TECHNOLOGIES DEPLOYMENT (ATCMTD)

The FAST Act established the Advanced Transportation and Congestion Management Technologies Deployment Program to make competitive grants for the development of model deployment sites for large scale installation and operation of advanced transportation technologies to improve safety, efficiency, system performance, and infrastructure return on investment.

Grant recipients may use funds under this program to deploy advanced transportation and congestion management technologies, including:

- Advanced traveler information systems;
- Advanced transportation management technologies;
- Infrastructure maintenance, monitoring, and condition assessment;
- Advanced public transportation systems;
- Transportation system performance data collection, analysis, and dissemination systems;
- Advanced safety systems, including vehicle-to-vehicle and vehicle-to-infrastructure communications;
- Technologies associated with autonomous vehicles, and other collision avoidance technologies, including systems using cellular technology;
- Integration of intelligent transportation systems with the smart grid and other energy distribution and charging systems;
- Electronic pricing and payment systems; or
- Advanced mobility and access technologies, such as dynamic ridesharing and information systems to support human services for elderly and disabled individuals.

A grant recipient may use up to 5% of the funds awarded each fiscal year to carry out planning and reporting requirements under the program. The federal share of the project cost is limited to a maximum of 50 % under this program.

INFRASTRUCTURE INVESTMENT AND JOBS ACT

As of November 2021, and as a result of the Covid-19 Pandemic, Congress passed the Bipartisan Infrastructure Deal (Infrastructure Investment and Jobs Act, also known as IIJA) which constitutes a $550 billion new spending investment in our nation's infrastructure over ten years. This act includes a substantial amount of funding to rebuild roads, bridges and rails, expand access to clean drinking water, ensure every American has access to high-speed internet, tackle the climate crisis, advance environmental justice, and invest in communities that have too often been left behind. This includes funding for the following measures:

- Providing clean water - $55 billion
- Access to reliable high-speed internet - $65 billion
- Repair and rebuild infrastructure - $110 billion
- Improving transit - $89.9 billion
- Upgrading airport - $17 billion

- Invest in passenger rail - $66 billion
- Build EV charger network - $7.5 billion
- Upgrade power infrastructure - $65 billions
- Improve resilience against cyber threats - $50 billion
- Address environmental threats - $21 billion

It is expected that the US Department of Transportation will direct a large portion of the funding via formula-based and competitive grants, agency programs and operations, loans, and the Highway Trust Fund. The formula-based grants amount to about $300 billion of the funding and are expected to be disbursed to states based on formulas which take into account various factors, with Texas and California taking a large majority due to being the two states with the most highway infrastructure. Caltrans will likely administer the funds, though it is unclear at this time what funding and grant programs are anticipated.

State Funding Opportunities

The State Highway Account is essentially a bank account that funds a variety of California programs for transportation and traveler mobility purposes. The SHA receives its fund from the State Base Excise Tax and the Federal Highway Trust Fund. The programs that are relevant to the City of Alameda are described below.

STATE/REGIONAL/INTERREGIONAL TRANSPORTATION IMPROVEMENT PROGRAM (STIP/RTIP/ITIP)

The State Transportation Improvement Program (STIP) is a multi-year capital improvement program resource management document to assist the State and local entities to plan and implement transportation improvements, and to utilize resources in a cost-effective manner. All STIP projects must be capital projects (including project development costs) needed to improve transportation. These projects generally may include, but are not limited to, improving State highways, local roads, public transit (including buses), intercity rail, pedestrian and bicycle facilities, grade separations, transportation system management, transportation demand management, sound walls, intermodal facilities, safety, and environmental enhancement and mitigation projects. STIP funding is split 25 percent to Interregional Transportation Improvement Program (ITIP) projects nominated by Caltrans, and 75 percent to Regional Transportation Improvement Program (RTIP) projects decided by regional agencies. Projects are presented as part of a complete ITIP or RTIP to the CTC for approval and inclusion in the STIP. The CTC, upon review of the ITIP or RTIP, can accept or reject the program in its entirety.

This is a multiyear Capital Improvement Program. The cycle begins in July of odd numbered years with the release of the funding estimate. The STIP/RTIP/ITIP is submitted on December 15th of every odd numbered year. Local agencies must work with their Metropolitan Planning Organization (MPO) to get their projects included in the RTIP for nomination. In this case, the City of Alameda would work with MTC to include City projects within the regional plan.

HIGHWAY SAFETY IMPROVEMENT PROGRAM (HSIP)

HSIP funds are administered by Caltrans. Caltrans initiated safety projects are eligible for HSIP funding if they are participating with a local agency. These projects typically included updated traffic signals or other projects that lend themselves to cost sharing between agencies and aim to improve safety via infrastructure. HSIP Grant funding is administered in cycles by Caltrans, with applications typically due in Fall of each year.

Local Funding Opportunities

AMERICAN RESCUE PLAN ACT OF 2021 (ARPA)

As a result of the Covid-19 Pandemic, Congress passed the American Rescue Plan Action of 2021 which allocated about $10 billion for states to cover the cost of capital projects like broadband infrastructure along with a multitude of social relief programs. Funds allocated by this program must be obligated by the States by the end of 2024 and spent by the end of 2026. The City of Alameda was awarded $28.68 million in July 2021 and City Council has already began allocating these monies towards initiatives and projects within the City, including potentially considering a $6 million allocation to Smart City efforts.

MTC-SPONSORED PROGRAMS AND GRANTS

MTC has implemented several funding programs in the past years with funding opportunities for ITS and Technology projects in the San Francisco Bay Area. The programs include Program for Arterial System Synchronization (PASS), NextGen Arterials, One Bay Area Grant (OBAG), Active Transportation Program, and Innovative Deployments to Enhance Arterials (IDEA). MTC sponsors the PASS program which aims to make the Bay Area's major City streets and County roads both safer and efficient. The funding provides for engineering assistance for signal timing, TSP integration and adjustment, responsive timing adjustments, incident planning and timing, as well as hardware procurement. The success of this program spawned a new program called NextGen Arterials, which assists Cities with implementation of new traffic technologies like adaptive timing, real-time traffic monitoring, queue-jump lanes, and Bluetooth systems.

MTC also sponsored the OBAG program which had two funding cycles and aimed to improve priority development areas, especially those with planned future housing. The funding was to be used for street maintenance and enhancement, bicycle and pedestrian improvements, transportation planning, and safe routes to school. MTC also provided $13 million in funding for the IDEA program, challenging Cities to improve the C/AV readiness of major arterials while improving operations for vehicles and transit. While applications for these programs are not currently open, it is probable that these or new iterations of these types of funding programs may return in the coming years.

ALAMEDA COUNTY TRANSPORTATION COMMISSION PROGRAMS AND GRANTS

Alameda County manages a streamlined program called the Comprehensive Investment Plan (CIP) which consolidates available funding under ACTC's management. The program prioritizes, evaluates, and recommends funding to critical transportation infrastructure and operations needs that build and maintain the County's transportation network. The program is updated annually, and proposals and new projects are considered on two-year cycles. The most recent call for projects for 2022 included a request for projects in specific categories (bicycle and/or pedestrian, transit, shuttle operations, and plans or studies) and was for projects that are ready for implementation in the next several fiscal years (2021/22 through 2025/26). It is expected that another call will be available for 2024.

PUBLIC-PRIVATE PARTNERSHIPS (P3)

P3s can provide alternative funding sources for transportation projects when a public agency enters into a partnership/agreement with a third-party private company. Essentially, the public agency brings in a private-sector firm who provides development, operation, and financing mechanisms for the transportation project. P3s have become more popular as public resources become more limited and the demand for improved transportation systems

continues to increase. There are benefits and limitations to engaging in a public/private partnership, so it is important to weigh those factors prior to P3 implementation.

SMART CITY IMPACT FEE DEVELOPMENT

As allowed by the Mitigation Fee Act of the California Government Code (Sections 66000 *et seq.),* impact fees are utilized by the City to support future development in the City by charging new developments fees such that private developments pay their fair share of the impacts their developments have to public facilities and infrastructure. These funds are then used to expand the facilities and infrastructure that supports the developments. The City completed its most recent Development Impact Fee Update and Nexus Study in 2014, with an update in 2017, and the study is intended to support future development in the City through 2040. In order to fund local projects, the City may consider the development of a new impact fee or expansion of the existing development impact fee that accounts for the build out of planned Smart City projects.

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APPENDIX A: Signal Equipment Existing Conditions Table

NO.	INTERSECTION	CABINET TYPE	CONTROLLER	DETECTION	BBS	TSP PREEMPT TYPE	COMM TYPE
1	Harbor Bay Pkwy & Ron Cowan Pkwy	NEMA P					
2	Harbor Bay Pkwy & Maitland Dr	NEMA P		VDS			
3	Doolittle Dr & Harbor Bay Pkwy	332		Loops	Yes		
4	Packet Landing Rd & Robert Davey Jr Dr	NEMA P		VDS	Yes		
5	Robert Davey Jr Dr & Island Dr	NEMA P			Yes		
6	Doolittle Dr & Island Dr	332	ASC/3	Loops	Yes		
7	Fernside Blvd & Otis Dr	332	ASC/3	Loops	Yes		
8	Encinal Ave & Fernside Blvd	NEMA P	ASC/3	VDS/Loops			
9	Fernside Blvd & High St	NEMA P	ASC/3	VDS/Loops	Yes	Infrared	
10	High St & Santa Clara Ave	NEMA P	ASC/3S	Loops			
11	Central Ave & High St	NEMA P	ASC/3	Loops			
12	Encinal Ave & High St	NEMA P	ASC/2S	Loops			
13	High St & Otis Dr	NEMA P	ASC/3	Loops	Yes		
14	Broadway & Otis Dr	NEMA P	ASC/3	VDS	Yes		
15	Broadway & Encinal Ave	Type G	ASC/3				
16	Broadway & Central Ave	Type G					
17	Broadway & Santa Clara Ave	Type G					
18	Broadway & Buena Vista Ave	NEMA P	Cobalt	VDS/Loops			
19	Broadway & Tilden Way	NEMA P	Cobalt	VDS/Loops			
20	Fernside Blvd- Blanding Ave & Tilden Way-Fruitvale Ave	NEMA P	ASC/3	Loops			
21	Blanding Ave & Park St	NEMA P		VDS	Yes	Infrared	Wireless
22	Clement Ave & Park St	NEMA P		VDS	Yes		Wireless
23	Buena Vista Ave & Park St	NEMA P	Cobalt	VDS			Wireless
24	Lincoln Ave & Park St & Tilden Way	NEMA P	Cobalt	VDS			Wireless
25	Park St & Santa Clara Ave	NEMA P		VDS			Wireless
26	Central Ave & Park St	NEMA P		VDS			Wireless
27	Alameda Ave & Park St	NEMA P		Loops	Yes		Wireless
28	Buena Vista Ave & Tilden Way	Type G	ASC/2S				
29	Encinal Ave & Park St	332			Yes		Wireless
30	Park St & San Jose Ave	Type G					
31	Otis Dr & Park St	NEMA P		VDS	Yes		
32	Otis Dr & Southshore Center West	NEMA P	ASC/3	Loops	Yes	Infrared	
33	Otis Dr & Willow St	NEMA P	ASC/3	Loops	Yes		
34	Buena Vista Ave & Oak St	Type G	ASC/2S	Loops			
35	Lincoln Ave & Oak St	Type G	ASC/2S				
36	Oak St & Santa Clara Ave	Type G	ASC/2S				
37	Central Ave & Oak St	Type G	ASC/2S				
38	Encinal Ave & Oak St	Type G	ASC/2S				
39	Encinal Ave & Walnut St	332	ASC/3	Loops			
40	Lincoln Ave & Willow St	Type G	ASC/2S				
41	Chestnut St & Lincoln Ave	Type G	ASC/2S				
42	Encinal Ave & Willow St	332	ASC/3		Yes		
43	Chestnut St & Encinal Ave	Type G	ASC/2S				
44	Grand St & Otis Dr	Type G	ASC/2S				
45	Encinal Ave & Grand St	Type G	ASC/2S				
46	Central Ave & Grand St	Type G	ASC/3	Loops			

NO.	INTERSECTION	CABINET TYPE	CONTROLLER	DETECTION	BBS	TSP PREEMPT TYPE	COMM TYPE
47	Grand St & Santa Clara Ave	Type G	ASC/3	Loops			
48	Grand St & Lincoln. Ave	Type G	ASC/2S				
49	Buena Vista Ave & Grand St	Type G	ASC/2S				
50	Buena Vista Ave & Sherman St	NEMA P	ASC/2	Loops			
51	Lincoln Ave & Sherman St	Type G	ASC/2				
52	Central Ave & Sherman St	332			Yes		
53	Otis Dr & Westline Dr	NEMA P	Cobalt	Loops	Yes		
54	8th St & Central Ave	332			Yes		
55	8th St & Santa Clara Ave	NEMA P			Yes		
56	8th St & Constitution Way & Lincoln Ave	NEMA P		Loops	Yes		Wireless
57	Buena Vista Ave & Constitution Way	NEMA P		Loops	Yes		Wireless
58	Atlantic Ave & Constitution Way	NEMA P		Loops	Yes		Wireless
59	Constitution Way & Marina Village Pkwy	NEMA P	ASC/3	Loops	Yes		
60	Challenger Dr & Marina Village Pkwy	NEMA P		Loops			
61	Challenger Dr & Atlantic Ave	NEMA P	ASC/2	Loops			
62	Mariner Square Dr & Constitution Way	NEMA P		VDS	Yes		
63	Atlantic Ave-Ralph Appezzato Memorial Pkwy & Webster St	NEMA P		VDS		GPS	Wireless
65	Webster St & Willie Stargell Ave	332		Loops	Yes	GPS	Wireless
66	Buena Vista Ave & Webster St	332	ASC/3	VDS		GPS	Wireless
67	Lincoln Ave & Webster St	332		VDS	Yes	GPS	Wireless
68	Santa Clara Ave & Webster St	332	ASC/3	VDS	Yes	GPS	Wireless
69	Central Ave & Webster St	Type G		VDS	Yes	Infrared	Wireless
70	Pacific Ave & Webster St	NEMA P		VDS	Yes	GPS	Wireless
71	4th St-Ballena Blvd & Central Ave	NEMA P		VDS			
72	Marshall Way & 5th St & Lincoln Ave	NEMA P		Loops			
73	Campus Dr & Ralph Appezzato Memorial Pkwy	NEMA P		Loops			
74	5th St & Ralph Appezzato Memorial Pkwy	NEMA P		Loops			
75	Coral Sea St & Poggi St & Ralph Appezzato Memorial Pkwy	NEMA P		VDS			
76	3rd St & Mosley Ave & Ralph Appezzato Memorial Pkwy	NEMA P		Loops			
77	Main St & R. Appezzato Mem Pkwy & W Atlantic Ave	NEMA P		VDS			
78	Central Ave-Main St & Pacific Ave-W Pacific Ave	NEMA P		Loops			
79	3rd St & Pacific Ave	Type G					
80	Hancock St & W Midway Ave	NEMA P		VDS			
81	Main St & Singleton Ave	NEMA P		VDS/Loops			
82	Main St & Ferry Terminal	NEMA P					
83	Mariner Square Loop & Willie Stargell Ave	NEMA P		VDS	Yes		
84	5th St & Willie Stargell Ave	NEMA P		VDS	Yes	GPS	
85	5th St & Singleton Ave	NEMA P		VDS	Yes		
86	5th St & Mitchell Ave	NEMA P	ASC/3	VDS	Yes	GPS	

NO.	INTERSECTION	CABINET TYPE	CONTROLLER	DETECTION	BBS	TSP PREEMPT TYPE	COMM TYPE
87	Mariner Square Loop & Mitchell Ave	NEMA P		VDS	Yes	GPS	
88	Harbor Bay Pkwy & N. Loop Rd/S. Loop Rd	NEMA P	Cobalt	VDS	Yes		
89	Harbor Bay Pkwy & Penumbra/S. Loop Rd	NEMA P	Cobalt	VDS	Yes		

A APPENDIX

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APPENDIX B: Project Cost Details

City of Alameda Smart City Master Plan
Planning-Level Cost Estimates

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Smart City Master Plan Summary			
Project Name			TotalCost
Communications Projects (Recommendations #1 & 8)	No. Signals	No. Facilities	
Project C1: Central City & EOC Communications Project	17	4	$5,057,166
Project C2: City Hall West Interconnection Project	15	3	$5,647,418
Project C3: Encinal Avenue Interconnect Project	12	2	$3,887,144
Project C4: South Island Access Communications Project	15	0	$3,827,409
Project C5: North Island Communications Project	13	0	$3,164,972
Project C6: South Shore Communications Project	8	1	$3,153,960
Project C7: Bay Farm Communications Project	8	1	$5,201,052
Public Wi-Fi Projects (Recommendation #2)	No. Locations	No. Zones	
Project W1: Central Public Wi-Fi	7	2	$2,123,856
Project W2: Northern Public Wi-Fi	8	2	$1,072,764
Project W3: Southern Public Wi-Fi	5	1	$812,700
Project W4: Bay Farm Public Wi-Fi	4	0	$345,032
Citywide EVP/TSP (Recommendations #3 &4)	No. Locations		
T1: Citywide EVP/TSP Deployment	72		$3,222,420
Centralized Transportation Management (Recommendation #7)			
T2: Centralized Transportation Mangement			$1,424,160
Transportation Analytics (Reccomendation #9)			
T3: Implement Transportation Analytics			$4,485,055
Citywide CCTV (Recommendation #10)	No. Locations		
Project T4: Citywide CCTV Deployment	13		$872,040
Staff Projects (Recommendations #5 & 6)			
Project S1: Partner with ISPs			$100,000
Project S2: Develop Dig Once & Installation Standard Policies			$100,000
		Master Plan Total	***$44,497,147***

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Project C1: Central City & EOC Communications Project				
Item	Quantity	Unit	Unit Price	Total
Traffic Control and Mobilization (~5%) + Misc. Work	1	LS	$140,100.00	$140,100
Fiber optic cable[1]	29550	LF	$15.00	$443,250
3 inch conduit[2]	22930	LF	$65.00	$1,490,450
Fiber optic pull box (N48)[3]	21	EA	$5,500.00	$115,500
Pull box (No. 6E)[3]	99	EA	$3,500.00	$346,500
Splice closure	21	EA	$2,000.00	$42,000
Splicing (at signals)[4]	17	EA	$500.00	$8,500
Splicing (at Key Facilities)[4]	4	EA	$3,500.00	$14,000
Testing	1	LS	$47,000.00	$47,000
Cabinet 12-port Fiber Termination Panel	21	EA	$750.00	$15,750
Ethernet Switch	21	EA	$5,000.00	$105,000
Wireless Communication Assembly	0	EA	$30,000.00	$0
Central/Hub supporting equipment & hardware	1	LS	$150,000.00	$150,000
Tracer Wire	29550	LF	$0.50	$14,775
Mule Tape	29550	LF	$0.25	$7,388
			Subtotal (Construction):	*$2,940,213*
			Design (15%)	$441,032
			Construction Mangement (15%)	$441,032
			Environmental Clearance (5%)	$147,011
			Staff Time (2%)	$58,804
			Subtotal (Design, CM, Environmental, Staff Time)	*$1,087,879*
			Contingency (35%):	*$1,029,074*
			Project Total:	***$5,057,166***

Notes:

[1] Includes all cable (trunk and drop) and accounts for vertical and slack cabling

[2] Assumes trenching of new conduits.

[3] Includes minor restoration work around pull box installations.

[4] Splicing per location (up to 12 splices)

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Project C2: City Hall West Interconnection Project				
Item	Quantity	Unit	Unit Price	Total
Traffic Control and Mobilization (~5%) + Misc. Work	1	LS	$156,400.00	$156,400
Fiber optic cable[1]	36710	LF	$15.00	$550,650
3 inch conduit[2]	27320	LF	$65.00	$1,775,800
Fiber optic pull box (N48)[3]	18	EA	$5,500.00	$99,000
Pull box (No. 6E)[3]	123	EA	$3,500.00	$430,500
Splice closure	18	EA	$2,000.00	$36,000
Splicing (at signals)[4]	15	EA	$500.00	$7,500
Splicing (at Key Facilities)[4]	3	EA	$3,500.00	$10,500
Testing	1	LS	$53,000.00	$53,000
Cabinet 12-port Fiber Termination Panel	18	EA	$750.00	$13,500
Ethernet Switch	18	EA	$3,500.00	$63,000
Wireless Communication Assembly	2	EA	$30,000.00	$60,000
Central/Hub supporting equipment & hardware	0	LS	$150,000.00	$0
Tracer Wire	36710	LF	$0.50	$18,355
Mule Tape	36710	LF	$0.25	$9,178
			Subtotal (Construction):	*$3,283,383*
			Design (15%)	$492,507
			Construction Mangement (15%)	$492,507
			Environmental Clearance (5%)	$164,169
			Staff Time (2%)	$65,668
			Subtotal (Design, CM, Environmental, Staff Time)	*$1,214,852*
			Contingency (35%):	*$1,149,184*
			Project Total:	***$5,647,418***

Notes:

[1] Includes all cable (trunk and drop) and accounts for vertical and slack cabling

[2] Assumes trenching of new conduits.

[3] Includes minor restoration work around pull box installations.

[4] Splicing per location (up to 12 splices)

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Project C3: Encinal Avenue Interconnect Project				
Item	Quantity	Unit	Unit Price	Total
Traffic Control and Mobilization (~5%) + Misc. Work	1	LS	$107,700.00	$107,700
Fiber optic cable[1]	22890	LF	$15.00	$343,350
3 inch conduit[2]	20150	LF	$65.00	$1,309,750
Fiber optic pull box (N48)[3]	14	EA	$5,500.00	$77,000
Pull box (No. 6E)[3]	77	EA	$3,500.00	$269,500
Splice closure	14	EA	$2,000.00	$28,000
Splicing (at signals)[4]	12	EA	$500.00	$6,000
Splicing (at Key Facilities)[4]	2	EA	$3,500.00	$7,000
Testing	1	LS	$35,000.00	$35,000
Cabinet 12-port Fiber Termination Panel	14	EA	$750.00	$10,500
Ethernet Switch	14	EA	$3,500.00	$49,000
Wireless Communication Assembly	0	EA	$30,000.00	$0
Central/Hub supporting equipment & hardware	0	LS	$150,000.00	$0
Tracer Wire	22890	LF	$0.50	$11,445
Mule Tape	22890	LF	$0.25	$5,723
			Subtotal (Construction):	*$2,259,968*
			Design (15%)	$338,995
			Construction Mangement (15%)	$338,995
			Environmental Clearance (5%)	$112,998
			Staff Time (2%)	$45,199
			Subtotal (Design, CM, Environmental, Staff Time)	*$836,188*
			Contingency (35%):	*$790,989*
			Project Total:	***$3,887,144***

Notes:

[1] Includes all cable (trunk and drop) and accounts for vertical and slack cabling

[2] Assumes trenching of new conduits.

[3] Includes minor restoration work around pull box installations.

[4] Splicing per location (up to 12 splices)

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Project C4: South Island Access Communications Project				
Item	Quantity	Unit	Unit Price	Total
Traffic Control and Mobilization (~5%) + Misc. Work	1	LS	$106,000.00	$106,000
Fiber optic cable[1]	22450	LF	$15.00	$336,750
3 inch conduit[2]	19760	LF	$65.00	$1,284,400
Fiber optic pull box (N48)[3]	15	EA	$5,500.00	$82,500
Pull box (No. 6E)[3]	75	EA	$3,500.00	$262,500
Splice closure	15	EA	$2,000.00	$30,000
Splicing (at signals)[4]	15	EA	$500.00	$7,500
Splicing (at Key Facilities)[4]	0	EA	$3,500.00	$0
Testing	1	LS	$35,000.00	$35,000
Cabinet 12-port Fiber Termination Panel	15	EA	$750.00	$11,250
Ethernet Switch	15	EA	$3,500.00	$52,500
Wireless Communication Assembly	0	EA	$30,000.00	$0
Central/Hub supporting equipment & hardware	0	LS	$150,000.00	$0
Tracer Wire	22450	LF	$0.50	$11,225
Mule Tape	22450	LF	$0.25	$5,613
			Subtotal (Construction):	*$2,225,238*
			Design (15%)	$333,786
			Construction Mangement (15%)	$333,786
			Environmental Clearance (5%)	$111,262
			Staff Time (2%)	$44,505
			Subtotal (Design, CM, Environmental, Staff Time)	*$823,338*
			Contingency (35%):	*$778,833*
			Project Total:	***$3,827,409***

Notes:

[1] Includes all cable (trunk and drop) and accounts for vertical and slack cabling

[2] Assumes trenching of new conduits.

[3] Includes minor restoration work around pull box installations.

[4] Splicing per location (up to 12 splices)

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Project C5: North Island Communications Project				
Item	Quantity	Unit	Unit Price	Total
Traffic Control and Mobilization (~5%) + Misc. Work	1	LS	$87,700.00	$87,700
Fiber optic cable[1]	25400	LF	$15.00	$381,000
3 inch conduit[2]	10440	LF	$65.00	$678,600
Fiber optic pull box (N48)[3]	13	EA	$5,500.00	$71,500
Pull box (No. 6E)[3]	85	EA	$3,500.00	$297,500
Splice closure	13	EA	$2,000.00	$26,000
Splicing (at signals)[4]	13	EA	$500.00	$6,500
Splicing (at Key Facilities)[4]	0	EA	$3,500.00	$0
Testing	1	LS	$37,000.00	$37,000
Cabinet 12-port Fiber Termination Panel	13	EA	$750.00	$9,750
Ethernet Switch	13	EA	$3,500.00	$45,500
Wireless Communication Assembly	6	EA	$30,000.00	$180,000
Central/Hub supporting equipment & hardware	0	LS	$150,000.00	$0
Tracer Wire	25400	LF	$0.50	$12,700
Mule Tape	25400	LF	$0.25	$6,350
			Subtotal (Construction):	*$1,840,100*
			Design (15%)	$276,015
			Construction Mangement (15%)	$276,015
			Environmental Clearance (5%)	$92,005
			Staff Time (2%)	$36,802
			Subtotal (Design, CM, Environmental, Staff Time)	*$680,837*
			Contingency (35%):	*$644,035*
			Project Total:	***$3,164,972***

Notes:

[1] Includes all cable (trunk and drop) and accounts for vertical and slack cabling

[2] Assumes trenching of new conduits.

[3] Includes minor restoration work around pull box installations.

[4] Splicing per location (up to 12 splices)

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Project C6: South Shore Communications Project				
Item	Quantity	Unit	Unit Price	Total
Traffic Control and Mobilization (~5%) + Misc. Work	1	LS	$87,400.00	$87,400
Fiber optic cable[1]	18930	LF	$15.00	$283,950
3 inch conduit[2]	16660	LF	$65.00	$1,082,900
Fiber optic pull box (N48)[3]	9	EA	$5,500.00	$49,500
Pull box (No. 6E)[3]	64	EA	$3,500.00	$224,000
Splice closure	9	EA	$2,000.00	$18,000
Splicing (at signals)[4]	8	EA	$500.00	$4,000
Splicing (at Key Facilities)[4]	1	EA	$3,500.00	$3,500
Testing	1	LS	$28,000.00	$28,000
Cabinet 12-port Fiber Termination Panel	9	EA	$750.00	$6,750
Ethernet Switch	9	EA	$3,500.00	$31,500
Wireless Communication Assembly	0	EA	$30,000.00	$0
Central/Hub supporting equipment & hardware	0	LS	$150,000.00	$0
Tracer Wire	18930	LF	$0.50	$9,465
Mule Tape	18930	LF	$0.25	$4,733
			Subtotal (Construction):	*$1,833,698*
			Design (15%)	$275,055
			Construction Mangement (15%)	$275,055
			Environmental Clearance (5%)	$91,685
			Staff Time (2%)	$36,674
			Subtotal (Design, CM, Environmental, Staff Time)	*$678,468*
			Contingency (35%):	*$641,794*
			Project Total:	***$3,153,960***

Notes:

[1] Includes all cable (trunk and drop) and accounts for vertical and slack cabling

[2] Assumes trenching of new conduits.

[3] Includes minor restoration work around pull box installations.

[4] Splicing per location (up to 12 splices)

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Project C7: Bay Farm Communications Project				
Item	Quantity	Unit	Unit Price	Total
Traffic Control and Mobilization (~5%) + Misc. Work	1	LS	$144,000.00	$144,000
Fiber optic cable[1]	31490	LF	$15.00	$472,350
3 inch conduit[2]	27710	LF	$65.00	$1,801,150
Fiber optic pull box (N48)[3]	9	EA	$5,500.00	$49,500
Pull box (No. 6E)[3]	105	EA	$3,500.00	$367,500
Splice closure	9	EA	$2,000.00	$18,000
Splicing (at signals)[4]	8	EA	$500.00	$4,000
Splicing (at Key Facilities)[4]	1	EA	$3,500.00	$3,500
Testing	1	LS	$42,000.00	$42,000
Cabinet 12-port Fiber Termination Panel	9	EA	$750.00	$6,750
Ethernet Switch	9	EA	$3,500.00	$31,500
Wireless Communication Assembly	2	EA	$30,000.00	$60,000
Central/Hub supporting equipment & hardware	0	LS	$150,000.00	$0
Tracer Wire	31490	LF	$0.50	$15,745
Mule Tape	31490	LF	$0.25	$7,873
			Subtotal (Construction):	*$3,023,868*
			Design (15%)	$453,580
			Construction Mangement (15%)	$453,580
			Environmental Clearance (5%)	$151,193
			Staff Time (2%)	$60,477
			Subtotal (Design, CM, Environmental, Staff Time)	*$1,118,831*
			Contingency (35%):	*$1,058,354*
			Project Total:	***$5,201,052***

Notes:

[1] Includes all cable (trunk and drop) and accounts for vertical and slack cabling

[2] Assumes trenching of new conduits.

[3] Includes minor restoration work around pull box installations.

[4] Splicing per location (up to 12 splices)

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Project W1: Central Public Wi-Fi Project				
Item	Quantity	Unit	Unit Price	Total
Traffic Control and Mobilization (~5%) + Misc. Work	1	LS	$58,800.00	$58,800
Fiber optic cable[1]	2250	LF	$20.00	$45,000
3 inch conduit[2]	1800	LF	$65.00	$117,000
Fiber optic pull box (N48)[3]	9	EA	$5,500.00	$49,500
Splice closure	9	EA	$2,000.00	$18,000
Splicing (at trunk connection)[4]	9	EA	$500.00	$4,500
Pole-Mounted Wi-Fi Cabinet	7	EA	$1,000.00	$7,000
Testing	1	LS	$5,000.00	$5,000
Ethernet Switch	9	EA	$5,000.00	$45,000
Wi-Fi Hotspot Assembly (Access Point + Cabling)[6]	7	EA	$15,000.00	$105,000
Wi-Fi Zone Equipment [5,6]	2	LS	$390,000.00	$780,000
			Subtotal (Construction):	*$1,234,800*
			Design (15%)	$185,220
			Construction Mangement (15%)	$185,220
			Environmental Clearance (5%)	$61,740
			Staff Time (2%)	$24,696
			Subtotal (Design, CM, Environmental, Staff Time)	*$456,876*
			Contingency (35%):	*$432,180*
			Project Total:	***$2,123,856***

Notes:

[1] Last mile connection to the communications network (assumed 200 LF), includes slack and vertical cabling.

[2] Assumes trenching of new conduits from Wi-Fi cabinet to splice point (assumed 200 LF).

[3] Includes minor restoration work around pull box installations.

[4] Splicing per location (up to 12 splices)

[5] Inclusive of all equipment to provide Wi-Fi in entire district (Mesh network equipment, cabinets, cabling, etc.)

[6] Assumes that AP's can be mounted on existing City-owned assets (street lights, building, power poles, etc.)

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Project W2: Northern Public Wi-Fi Project				
Item	Quantity	Unit	Unit Price	Total
Traffic Control and Mobilization (~5%) + Misc. Work	1	LS	$29,700.00	$29,700
Fiber optic cable[1]	2500	LF	$20.00	$50,000
3 inch conduit[2]	2000	LF	$65.00	$130,000
Fiber optic pull box (N48)[3]	10	EA	$5,500.00	$55,000
Splice closure	10	EA	$2,000.00	$20,000
Splicing (at trunk connection)[4]	10	EA	$500.00	$5,000
Pole-Mounted Wi-Fi Cabinet	8	EA	$1,000.00	$8,000
Testing	1	LS	$6,000.00	$6,000
Ethernet Switch	10	EA	$5,000.00	$50,000
Wi-Fi Hotspot Assembly (Access Point + Cabling)[6]	8	EA	$15,000.00	$120,000
Wi-Fi Zone Equipment [5,6]	2	LS	$75,000.00	$150,000
			Subtotal (Construction):	*$623,700*
			Design (15%)	$93,555
			Construction Mangement (15%)	$93,555
			Environmental Clearance (5%)	$31,185
			Staff Time (2%)	$12,474
			Subtotal (Design, CM, Environmental, Staff Time)	*$230,769*
			Contingency (35%):	*$218,295*
			Project Total:	***$1,072,764***

Notes:

[1] Last mile connection to the communications network (assumed 200 LF), includes slack and vertical cabling.

[2] Assumes trenching of new conduits from Wi-Fi cabinet to splice point (assumed 200 LF).

[3] Includes minor restoration work around pull box installations.

[4] Splicing per location (up to 12 splices)

[5] Inclusive of all equipment to provide Wi-Fi in entire district (Mesh network equipment, cabinets, cabling, etc.)

[6] Assumes that AP's can be mounted on existing City-owned assets (street lights, building, power poles, etc.)

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Project W3: Southern Public Wi-Fi Project				
Item	Quantity	Unit	Unit Price	Total
Traffic Control and Mobilization (~5%) + Misc. Work	1	LS	$22,500.00	$22,500
Fiber optic cable[1]	1500	LF	$20.00	$30,000
3 inch conduit[2]	1200	LF	$65.00	$78,000
Fiber optic pull box (N48)[3]	6	EA	$5,500.00	$33,000
Splice closure	6	EA	$2,000.00	$12,000
Splicing (at trunk connection)[4]	6	EA	$500.00	$3,000
Pole-Mounted Wi-Fi Cabinet	5	EA	$1,000.00	$5,000
Testing	1	LS	$4,000.00	$4,000
Ethernet Switch	6	EA	$5,000.00	$30,000
Wi-Fi Hotspot Assembly (Access Point + Cabling)[6]	5	EA	$15,000.00	$75,000
Wi-Fi Zone Equipment [5,6]	1	LS	$180,000.00	$180,000
			Subtotal (Construction):	*$472,500*
			Design (15%)	$70,875
			Construction Mangement (15%)	$70,875
			Environmental Clearance (5%)	$23,625
			Staff Time (2%)	$9,450
			Subtotal (Design, CM, Environmental, Staff Time)	*$174,825*
			Contingency (35%):	*$165,375*
			Project Total:	***$812,700***

Notes:

[1] Last mile connection to the communications network (assumed 200 LF), includes slack and vertical cabling.

[2] Assumes trenching of new conduits from Wi-Fi cabinet to splice point (assumed 200 LF).

[3] Includes minor restoration work around pull box installations.

[4] Splicing per location (up to 12 splices)

[5] Inclusive of all equipment to provide Wi-Fi in entire district (Mesh network equipment, cabinets, cabling, etc.)

[6] Assumes that AP's can be mounted on existing City-owned assets (street lights, building, power poles, etc.)

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Project W4: Bay Farm Public Wi-Fi Project				
Item	Quantity	Unit	Unit Price	Total
Traffic Control and Mobilization (~5%) + Misc. Work	1	LS	$9,600.00	$9,600
Fiber optic cable[1]	1000	LF	$20.00	$20,000
3 inch conduit[2]	800	LF	$65.00	$52,000
Fiber optic pull box (N48)[3]	4	EA	$5,500.00	$22,000
Splice closure	4	EA	$2,000.00	$8,000
Splicing (at trunk connection)[4]	4	EA	$500.00	$2,000
Pole-Mounted Wi-Fi Cabinet	4	EA	$1,000.00	$4,000
Testing	1	LS	$3,000.00	$3,000
Ethernet Switch	4	EA	$5,000.00	$20,000
Wi-Fi Hotspot Assembly (Access Point + Cabling)[6]	4	EA	$15,000.00	$60,000
Wi-Fi Zone Equipment [5,6]	0	LS	$0.00	$0
			Subtotal (Construction):	*$200,600*
			Design (15%)	$30,090
			Construction Mangement (15%)	$30,090
			Environmental Clearance (5%)	$10,030
			Staff Time (2%)	$4,012
			Subtotal (Design, CM, Environmental, Staff Time)	*$74,222*
			Contingency (35%):	*$70,210*
			Project Total:	***$345,032***

Notes:

[1] Last mile connection to the communications network (assumed 200 LF), includes slack and vertical cabling.

[2] Assumes trenching of new conduits from Wi-Fi cabinet to splice point (assumed 200 LF).

[3] Includes minor restoration work around pull box installations.

[4] Splicing per location (up to 12 splices)

[5] Inclusive of all equipment to provide Wi-Fi in entire district (Mesh network equipment, cabinets, cabling, etc.)

[6] Assumes that AP's can be mounted on existing City-owned assets (street lights, building, power poles, etc.)

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Investment T1: Citywide EVP/TSP Deployment				
Item	Quantity	Unit	Unit Price	Total
Furnish & Install Intersection EVP/TSP Assemblies[1]	72	LS	$25,000.00	$1,800,000
Furnish & Install EVP equipment on AFD vehicles	21	EA	$3,500.00	$73,500
			Subtotal (Construction):	*$1,873,500*
			Design (15%)	$281,025
			Construction Mangement (15%)	$281,025
			Environmental Clearance (5%)	$93,675
			Staff Time (2%)	$37,470
			Subtotal (Design, CM, Environmental, Staff Time)	*$693,195*
			Contingency (35%):	*$655,725*
			Project Total:	***$3,222,420***

Notes:

[1] Level of investment estimate will be to procure the EVP/TSP equipment and install on a per location basis.
Assembly includes GPS unit, phase selector, cabling, auxiliary panel - approx. $7,500 per intersection equipment, $2,500 install cost.

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Investment T2: Centralized Transportation Management				
Item	Quantity	Unit	Unit Price	Total
New Standard Traffic Signal Controller[1]	82	EA	$4,000.00	$328,000
Procure & Configure ATMS system (Centracs)	1	LS	$500,000.00	$500,000
			Subtotal (Construction):	*$828,000*
			Design (15%)	$124,200
			Construction Mangement (15%)	$124,200
			Environmental Clearance (5%)	$41,400
			Staff Time (2%)	$16,560
			Subtotal (Design, CM, Environmental, Staff Time)	*$306,360*
			Contingency (35%):	*$289,800*
			Project Total:	***$1,424,160***

Notes:
[1] Level of investment estimate will be to procure the controller equipment and install on a per location basis.

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Investment T3: Implement Transportation Analytics				
Item	Quantity	Unit	Unit Price	Total
Procure Signal Performance Measure (SPM) Solution[1]	89	EA	$3,500.00	$311,500
Third Party Data Solution Subscription[2]	3	YR	$50,000.00	$150,000
Deploy VDS at all City Intersections[3]	56	EA	$40,000.00	$2,240,000
			Subtotal (Construction & Procurement):	*$2,701,500*
			Design (15%)	$336,000
			Construction Mangement (15%)	$336,000
			Environmental Clearance (5%)	$112,000
			Staff Time (2%)	$54,030
			Subtotal (Design, CM, Environmental, Staff Time)	*$838,030*
			Contingency (35%):	*$945,525*
			Construction Project Total:	***$4,485,055***

Notes:

[1] Assumes a 3-year initial license, cost per intersection

[2] Assumes a 3-year initial license, cost is a yearly subscription fee

[3] Level of investment estimate will be to procure the VDS equipment and install on a per location basis. Optional item (not required to deploy SPM at intersections already equipped with VDS and/or loops)

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Project T4: Citywide CCTV Deployment				
Item	Quantity	Unit	Unit Price	Total
CCTV Assembly (installed at Traffic Signal)	13	EA	$20,000.00	$260,000
CCTV Assembly (installed at non-Traffic Signal location)	3	EA	$20,000.00	$60,000
CCTV Mounting Pole	3	EA	$10,000.00	$30,000
Fiber optic pull box (N48)[1]	3	EA	$5,500.00	$16,500
Splice closure	3	EA	$2,000.00	$6,000
Splicing (at signals)[2]	3	EA	$500.00	$1,500
Service Enclosure (via AMP)	3	EA	$7,500.00	$22,500
Ethernet Switch	3	EA	$3,500.00	$10,500
Video Mangement System	1	LS	$100,000.00	$100,000
			Subtotal (Construction):	*$507,000*
			Design (15%)	$76,050
			Construction Mangement (15%)	$76,050
			Environmental Clearance (5%)	$25,350
			Staff Time (2%)	$10,140
			Subtotal (Design, CM, Environmental, Staff Time)	*$187,590*
			Contingency (35%):	*$177,450*
			Project Total:	***$872,040***

Notes:

Project will be to procure the equipment and install CCTV on a per location basis.

[1] Includes minor restoration work around pull box installations.

[2] Splicing per location (up to 12 splices)